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MARSH MANUAL

MULTIPLE ATTRIBUTE RECOGNITION SYSTEM for HYDROPHYTES

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NATIONAL WETLANDS INVENTORY
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Directions for loading MARSH from distribution disk to hard disk.

The MARSH distribution disk contains one file named MARSH.EXE. This is a compressed file which when expanded will create a MARSH directory and WDYIMAG subdirectory with files totalling 2.5 million bytes.

Loading Instructions.

Place the distribution disk into the external disk drive (eg. A). Move to the root directory of the hard disk drive you wish to place MARSH on (eg. C). At the C:\ prompt, type A:\MARSH. This will begin the uncompression process and require you to respond to three questions. Type Y and press the return key in response to all questions. The process will automatically create a directory named MARSH with all key files and the MEKA program and a sub-directory named WDYIMAG with all files and a mouse-driven version of MEKA installed.

To activate the keying program in either the MARSH directory or the WDYIMAG sub-directory, type MEKA and press the return key.

MARSH MANUAL

MULTIPLE ATTRIBUTE RECOGNITION
SYSTEM for HYDROPHYTES

Project Coordinator

Porter B. Reed, Jr.
Wetland Ecologist
Fish and Wildlife Service

Funding Agencies

Fish and Wildlife Service

Army Corps of Engineers

Environmental Protection Agency

Soil Conservation Service

Technical Development

Data Collection and Analysis

Biota of North America Program (BONAP)
North Carolina Botanical Garden
University of North Carolina, Chapel Hill

Multiple-Entry Key Algorithm (MEKA)

Museum Informatics Project
University of California, Berkeley

MULTIPLE ATTRIBUTE RECOGNITION SYSTEM FOR HYDROPHYTES

Contents.

Introduction
Keys, Key Characters and Taxa

- **WOODY** - 509 characters, 830 taxa.
- **ASTER** - Asteraceae (Asters) - 323 characters, 522 taxa.
- **GRASS** - Poaceae (Grasses) - 323 characters, 532 taxa.
- **CYPER** - Cyperaceae (Sedges) except Carex - 323 characters, 310 characters.
- **CAREX** - 323 characters, 296 taxa.
- **JUNCUS** - Juncaceae (Rushes) - 323 characters, 104 taxa.
- Pteridophyta (Ferns and fern allies)
- **FERN** - True ferns - 205 characters, 102 taxa.
- **AZOLLA** - Mosquito and Water Ferns - 101 characters, 5 taxa.
- **EQUISET** - Horsetails - 116 characters, 10 taxa.
- **ISOETES** - Quillworts - 112 characters, 15 taxa.
- **MARSILEA** - Water-clovers - 121 characters, 4 taxa.
- **SELAGINE** - Spike-mosses - 141 characters, 21 taxa.

MEKA manual
Tutorial
Distribution disk

Introduction.

The Fish and Wildlife Service, in cooperation with the Environmental Protection Agency, Corps of Engineers, and Soil Conservation Service, produced the National List of Plant Species that Occur in Wetlands (Reed 1988). This National List provides the vegetative indicators used in the Corps of Engineers Wetland Delineation Manual (1987). The National List of Plant Species That Occur in Wetlands follows the National List of Scientific Plant Names (1982) produced by the Soil Conservation Service. This Multiple Attribute Recognition System for Hydrophytes (MARSH) follows A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland (Kartesz in press). The National List of Plant Species That Occur in Wetlands will be modified to reflect this new National Checklist.

The four Federal agencies are cooperatively developing this computer assisted identification system to aid field biologists to more efficiently identify the vascular plant species occurring on the National List. MARSH is being developed through a cooperative agreement with the Biota of North America Program at the North Carolina Botanical Garden, University of North Carolina, Chapel Hill. Approximately 3,000 species (Pteridophyta, Poaceae, Cyperaceae, Juncaceae, Asteraceae, and all woody species) have now been reviewed and their morphological characteristics and geographic distribution to the state-level recorded. Ecological and geographic (to the county-level) data is anticipated to be added in the future for each species as additional "characters" to aid in the computer identification process.

This release contains keys to the Pteridophyta (Ferns and Fern Allies), Poaceae (Grasses), Cyperaceae (Sedges), Juncaceae (Rushes), Asteraceae (Asters), and woody species on the National List which occur in the continental United States. The morphological and geographical information was compiled by the Biota of North America Program under the direction of Dr. John T. Kartesz, assisted by Dr. Kancheepuram N. Gandhi and Ms. Carolyn Wilczynski. Additional data on Carex was supplied by Dr. Miriam C. Fritts via the polyclave for the Carices of the Western United States. The data for each key was assembled by the following specialist(s):

Woody Key - Dr. John T. Kartesz
Aster Key - Dr. Kancheepuram N. Gandhi
Grass Key - Dr. Kancheepuram N. Gandhi
Cyper and Carex Keys - Dr. Kancheepuram N. Gandhi
Juncus Key - Dr. Kancheepuram N. Gandhi
Ferns and fern allies Keys - Ms. Carolyn Wilczynski and Dr. John T. Kartesz

The Multiple Entry Key Algorithm (MEKA) which provides the computer keying program was developed at the University Herbarium, University of California at Berkeley (Duncan and Meacham 1987).

The use of a random access procedure to select from a polyclave of morphological characteristics those which characterize a particular taxa is not a new idea. A polyclave allows a series of characteristics to be specified which sequentially reduces the taxa possessing a unique combination of characters to a single taxon. The order in which the characters are enumerated is not fixed and no specific pathway is required. The power of the system derives from the intuitive method used to select from a large number of characters that subset which characterizes an unknown specimen. No system will identify all specimens correctly all the time due to the variability in character states expressed by some plant specimens. The advantage of a computerized system is that the characters present on an unknown specimen can be specified in any sequence and this resulting collective association of linked characters will finally result in a single species identification. MARSH replicates the cognitive process of specifying linked characters used by an experienced field botanist to identify an unknown plant specimen.

Traditional dichotomous keys in botanical manuals require the use of a specific series of character states, some of which may be absent or difficult to assign from the unknown specimen being identified. MARSH breaks the tradition of taxonomic dogma which incorporated phylogenetic relationships in identification keys by allowing the specification of characteristics irrespective of taxonomic lineage. Vegetative characters can be used as opposed to the floral characters required in many traditional dichotomous keys. Identification through random access of characteristics in a polyclave is based on the specification of diagnostic suites of consistent characters. It is implicit that all keys, including those based on random access of a polyclave of characteristics, will perform more effectively if directed access is provided to identify those characteristics which historically have proved to be most diagnostic. The additional advantage of a randomly accessed polyclave is that these historically solid characters can be combined with unique non-traditional characteristics. This allows the efficient identification of an unknown specimen by the specification of a diagnostic suite of a very few characteristics only possessed by this single species. Traditional keys typically have to leave out exceptional characteristics which uniquely define each species due to the complexity and volume of text this would entail. Geographical distribution, which is as strong as any morphological character, is totally ignored in most traditional keys but is easily incorporated as a powerful character in random access keys. The efficiency of use of a random access polyclave will be significantly increased as a user becomes more experienced and recognizes strongly diagnostic characters as opposed to weakly differentiating characters.

Installation and use of MEKA and MARSH keys.

Make a directory on your hard disk (MARSH is suggested) and uncompress the file on the distribution disk to the directory you have just created. The installation procedure on a hard disk is as follows:

C:	Set the default drive to C:.
MD MARSH	Create a directory \MARSH on this drive.
CD MARSH	Make this the default directory.
A:\MARSH	Place the distribution disk in drive A: and extract the set of files.
DIR/P	Look at the files extracted from the A: drive and placed in the \MARSH directory.

The MARSH system is now ready to use.

A MEKA key consists of four files. One file (.des) contains text that describes the nature and source of the data, a second (.chr) contains brief descriptions of the characters used in the key, a third (.tax) contains the names of the taxa used in the key, and a fourth (.dat) contains the data matrix arranged as characters by taxa.

Log into the MARSH directory containing the data files. Type 'MEKA' to begin the program and then type the name of the key (eg. 'ASTERS') in response to the name of the key to be used. MEKA will respond with the name of the key selected, the number of taxa and characters contained in the key, and the statement ENTER COMMAND. Entering 'MC' or '?' will display a list of the MEKA commands on the screen. Entering 'QU' will exit the program and return to the DOS operating system. An initial user will need to refer to the MEKA manual and tutorial for the woody key provided in this document. A copy of the MEKA manual (Version 1.3) is included as part of this document. The manual provides a detailed description of the commands and procedures used in MEKA and MEKAEDIT.

In the identification of an unknown specimen, the initial task is to develop a character list using the characters displayed by a specimen, paying special attention to all critical characters for the group identified by an *. The one page list of characters provided for each key provides an ideal work-sheet for recording the characters observed on the unknown specimen.

MEKA selects all taxa possessing the combination of characters which have been specified when the KEY OUT command is given. The process is usually iterative with additional characters further narrowing the possible candidates down to a single taxon. Some characters are more diagnostic than others. The characters which are most obvious on the specimen should generally be specified first.

If all species are eliminated by the combination of characters you have specified, review your specimen closely to identify which character(s) was specified in error and to select alternative characters. Delete one at a time those characters which may not be correctly assigned or may represent an incorrect subjective assessment. Key out using the remaining characters to determine if one or more taxa match the reduced or revised set of characters. When a single species is determined, check the identification against a full description of the species and a photograph or line drawing.

Characters were selected that were constant and reliable across the United States. Some characters were eliminated which were constant and reliable in one or more regions but not across the entire United States. We anticipate that these keys will be distributed in regional sets and thus some of the characters previously eliminated may eventually be incorporated.

CAUTION: The characters selected for this key will identify taxa included on the National List of Plant Species That Occur in Wetlands, but may give a totally erroneous identification for a non-wetland taxa. Identification of specimens collected near the drier edge of wetlands or during dry periods should be examined especially critically.

The MEKA manual also contains on pages 12-14 guidance on the use of MEKAEDIT which can be used to modify existing keys or create new keys. Space has been left in each key for the incorporation of additional characters.

Refinement of Keys.

The characters and their character state for each taxa chosen to aid in the identification of the groups contained in this release were derived from descriptions in botanical manuals and papers and from the inspection of normal, mature herbarium specimens. On the average, approximately 40 percent of the character assignments used in the keys were extracted from monographs, revisionary and/or floristic literature. The remaining 60 percent of the character assignments was derived from dried and live specimens. We anticipate that some of the character states assigned to particular taxa will have to be revised and additional characters will need to be added to aid in the more efficient identification of taxa. We would most welcome suggestions for any changes you feel would improve the polyclave. A MARSH Testing Report Form is included as a guide for the submission of suggested changes to the character data in the keys. Please send all suggestions for changes to:

Mr. Porter B. Reed, Jr.
U.S. Fish and Wildlife Service
National Wetlands Inventory
Suite 101, Monroe Building
9720 Executive Center Drive
St. Petersburg, FL 33702-2440

All suggestions will be compiled and forwarded to Dr. John T. Kartesz for his review for incorporation into subsequent revisions of the keys.

The U.S. Fish and Wildlife Service will initiate and distribute a MARSH newsletter to all offices which notify Mr. Reed at the above address that they are participating in the testing of the initial release of the five keys. This newsletter will provide user guidance, documentation of minor key corrections, notices of the availability of enhanced or new keys or an enhanced version of MEKA, a forum for users to exchange information and procedures, announcement of the dates and locations for MARSH workshop training, and a list of offices and users testing the keys.

Literature Cited.

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Soil Conservation Service. 1982. National List of Scientific Plant Names, Vols. 1 and 2. SCS-TP-159. USDA, Soil Conservation Service, Wash., D.C.

MARSH TESTING REPORT FORM

Name:
Organization:
Address:
Phone:
Date:

Scientific Name and Authority:

Collection location:

Collection date:

Habitat:

Fresh or dried specimen:

Specimen or photocopy of specimen submitted with report:

MARSH key used:

Date of key (from DOS .DAT file):

Character number(s) and description(s):

Problem with character value assignment:

Suggestion for character refinement:

Documentation of character from a botanical manual or flora:

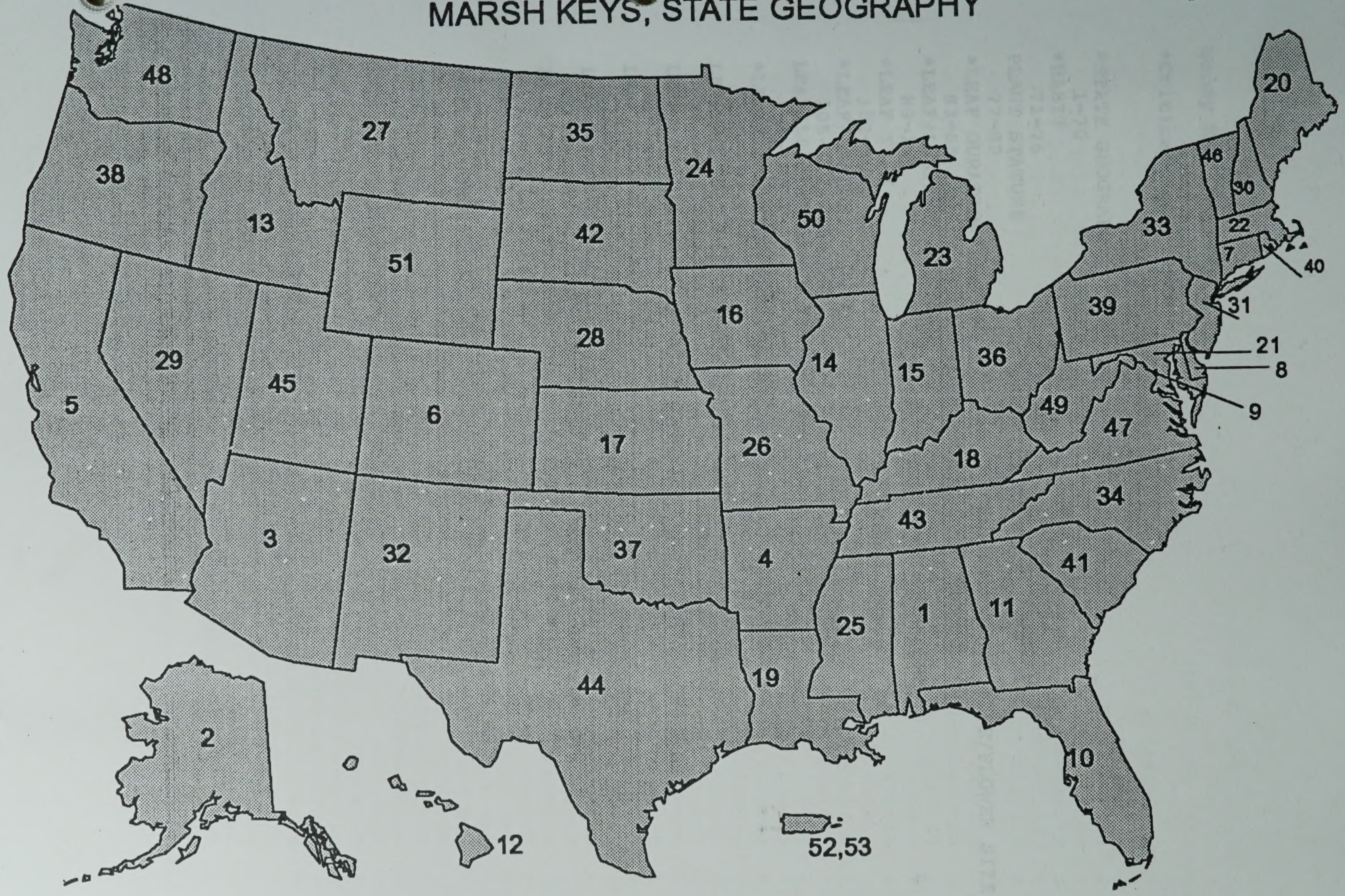
WOODY

General	Leaf	Flower Inflorescence	Fruit	Stem	Root
Geography 1–70	Position 88–101	Color 344–352	Texture 413–414	Bark 323–326	Form 507–508
Habit 71–76	Type/ # Leaflets 102–104 114–135	Type/ Shape 398–406 412	Color 418–427	Vestiture 328–340	Fragrance 509
Height/ Form 77–82	Margin 105–113 136–151	Position 352–394	Shape 415–417	Color 309–312 325–327	
Armament 490–504	Venation 252–260	Size 407–411	Size 439–451	Pith 314–322	
Latex 276–277	Vestiture/ Color 152–184	Fragrance 395–397	Vestiture 428–438	Shape 300–308	
Toxins 285–299	Texture/ Duration 83–85	Pistillate 355–358	Position 421–424	Spur Shoot 313	
Fragrance 503–506	Size 203–206 208–232	Petals 359–367	Cone 452–489		
Texture/ Duration 83–87 513	Shape 185–202 207	Part # 354–368			
Habitat 0–0	Apex/Base 233–251	Stamen 369–394			
	Stipules/ Petiole 192–197 261–275	Period/ Duration 341–343			
	Needle 278–280				

WOODY

General	Leaf	Flower/ Inflorescence	Fruit	Stem	Root
Geography 1–70	Position 89–101	Color 344–352	Texture 413–414	Bark 323–326	Form 507–508
Habit 71–76	Type/ #Leaflets 102–104 114–135	Type/ Shape 398–406 412	Color 418–427	Vestiture 328–340	Fragrance 509
Height/ Form 77–82	Margin 105–113 136–151	Position 353–354	Shape 415–417	Color 309–312 325–327	
Armament 490–504	Venation 252–260	Size 407–411	Size 439–451	Pith 314–322	
Latex 276–277	Vestiture/ Color 158–184	Fragrance 395–397	Vestiture 428–438	Shape 300–308	
Tendril 290–298	Texture/ Duration 83–88	Number 355–358	Position 353–354	Spur Shoot 299	
Fragrance 505–506	Size 203–206 208–232	Fusion 359–363	Cone 452–489		
Texture/ Duration 83–88 313	Shape 185–202 207	Part # 364–392			
Habitat 0–0	Apex/Base 233–251	Stamen 393–394			
	Stipule/ Petiole 152–157 261–275	Period/ Duration 341–343			
	Needle 278–289				

MARSH KEYS, STATE GEOGRAPHY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Woody Key Characters

*Critical Characters

*STATE GEOGRAPHY
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Woody Key, 508 Characters

*Critical Characters

*STATE GEOGRAPHY

1	**Alabama**
2	**Alaska**
3	**Arizona**
4	**Arkansas**
5	**California**
6	**Colorado**
7	**Connecticut**
8	**Delaware**
9	**District of Columbia**
10	**Florida**
11	**Georgia**
12	**Hawaii**
13	**Idaho**
14	**Illinois**
15	**Indiana**
16	**Iowa**
17	**Kansas**
18	**Kentucky**
19	**Louisiana**
20	**Maine**
21	**Maryland**
22	**Massachusetts**
23	**Michigan**
24	**Minnesota**
25	**Mississippi**
26	**Missouri**
27	**Montana**
28	**Nebraska**
29	**Nevada**
30	**New Hampshire**
31	**New Jersey**
32	**New Mexico**
33	**New York**
34	**North Carolina**
35	**North Dakota**
36	**Ohio**
37	**Oklahoma**
38	**Oregon**
39	**Pennsylvania**
40	**Rhode Island**
41	**South Carolina**
42	**South Dakota**
43	**Tennessee**
44	**Texas**
45	**Utah**
46	**Vermont**
47	**Virginia**

48 **Washington**
49 **West Virginia**
50 **Wisconsin**
51 **Wyoming**
52 **Puerto Rico**
53 **Virgin Islands**
54 **Alberta**
55 **British Columbia**
56 **Franklin**
57 **Keewatin**
58 **Labrador**
59 **MacKenzie**
60 **Manitoba**
61 **New Brunswick**
62 **Newfoundland**
63 **Nova Scotia**
64 **Ontario**
65 **Prince Edward Island**
66 **Quebec**
67 **Saskatchewan**
68 **Yukon Territory**
69 **Greenland (Denmark)**
70 **St. Pierre and Miquelon Islands (France)**

*HABIT
71 **Herbaceous or sub-shrub** (dwarf shrub <0.5 m)
72 **Shrub** (woody plant usually less than 4 meters tall and multiple branched at base)
73 **Vine or liana** (no plant heights are scored)
74 **Tree** (single stemmed with a Diameter Breast High >7.5 cm and >4 m tall at maturity)
75 **Palm-like**
76 **Cactus-like**

PLANT STATURE
77 **Erect** (stem upright)
78 **Trailing** (stem sprawling above the ground)
79 **Height <0.5 m at maturity**
80 **Height 0.5-1 m at maturity**
81 **Height 1-4 m at maturity**
82 **Height >4 m at maturity**

*LEAF DURATION/TEXTURE
83 **Deciduous** (leaves fall at end of one season of growth)
84 **Evergreen** (persistent leaves remain green during the dormant season)
85 **Membranaceous** (thin, rather soft, pliable and somewhat semi-transparent)
86 **Coriaceous** (thick and leathery, eg. Rhododendron)
87 **Succulent** (juicy and fleshy)
88 **Glossy** (shiny, highly polished or highly varnished surface)

*LEAF/LEAFLET POSITION (pertains to leaf position unless otherwise noted)

89 **Opposite** (two leaves at a node)
90 **Alternate** (one leaf at a node)
91 **Whorled** (three or more leaves at a node)
92 **Basal** (a crowded cluster of radiating leaves appearing to rise from the base of the plant)
93 **In fascicles** (condensed or close clusters with a common shared point of attachment) **of 2**
94 **In fascicles of 3-4**
95 **In fascicles of 5**
96 **In fascicles of 6+**
97 **Spirally arranged** (corkscrew orientation)
98 **Apically clustered** (clustered at tip with no common shared point of attachment)
99 **Leaves 2-ranked** (in one plane)
100 **Leaflets opposite**
101 **Leaflets alternate**

*LEAF TYPE

102 **Simple**

103 **Pinnately lobed**

104 **Palmately lobed**

105 **Lobes pointed apically**

106 **Lobes rounded apically**

107 **Leaf lobes <4**

108 **Leaf lobes 4-5**

109 **Leaf lobes 6-11**

110 **Leaf lobes 12-19**

111 **Leaf lobes 20+**

112 **Terminal leaf lobe concave** (margin of lobe from base curving inward immediately from base of lobe toward the center of the lobe)

113 **Terminal leaf lobe convex**(margin of lobe from base curving outward immediately from base of lobe away from the center of the lobe)

114 **Evenly pinnately compound** (comb shaped with individual leaflets)

115 **Oddly pinnately compound**

116 **Once pinnately compound**

117 **2 or 3 times pinnately compound**

118 **Palmately compound** (hand-shaped, the leaflets radiating from a common point)

119 **Leaflets 2** (smallest unit of a leaf, composing the ultimate complete division)

120 **Leaflets 3**

121 **Leaflets 4**

122 **Leaflets 5**

123 **Leaflets 6-7**

124 **Leaflets 8-9**

125 **Leaflets 10+**

126 **Pinnae per leaf 1** (the primary division or segment of a pinnately compound leaf)

127 **Pinnae per leaf 2**

128 **Pinnae per leaf 3-4**

129 **Pinnae per leaf 5-7**

130 **Pinnae per leaf 8+**

131 **Leaflets per pinna <4** (ultimate division or segment of a 2+ pinnately compound leaf)

132 **Leaflets per pinna 4-7**

133 **Leaflets per pinna 8-14**

134 **Leaflets per pinna 15+**

135 **Terminal leaflet longest**

*LEAF/LEAFLET MARGIN

136 **Leaf teeth/lobes cut less than halfway to midrib**
137 **Leaf teeth/lobes cut more than halfway to midrib**
138 **Entire** (without teeth)
139 **Toothed/lobed**
140 **Toothed/lobed above middle**
141 **Toothed/lobed below middle**
142 **Serrate** (sharp rather coarse saw-like teeth that point forward)
143 **Double-toothed**
144 **With 2-4 teeth on each side**
145 **Crenate** (scalloped or cut with small rounded teeth), **sinuate** (strongly wavy in and out, in the plane of the blade), **or scalloped**
146 **Dentate** (with coarse angular teeth directed outward at right angles to the margin) **or coarsely toothed**
147 **Revolute** (margin rolled under toward lower side of leaf)
148 **Leaf teeth glandular-tipped** (with minute dark-colored glands)
149 **Eglandular-ciliate** (fringed with fine hairs)
150 **Glandular-ciliate**
151 **Undulate** (margin wavy perpendicular to plane of blade)

LEAF/LEAFLET ATTACHMENT

152 **Lateral leaflets stalked**
153 **Lateral leaflets sessile**
154 **Terminal leaflet stalked**
155 **Terminal leaflet sessile**
156 **Leaves stalked** (any structure >1 mm used to elevate blade from base structure of branch)
157 **Leaves sessile**

LEAF/LEAFLET BLADE VESTITURE

158 **Papillose** (bearing minute, nipple-like projections)
159 **Glaucous** (covered with a whitened bloom or smooth waxy coating) **beneath**
160 **Glaucous above**
161 **Glabrous** (without hairs) **beneath with possible exception of midrib**
162 **Glabrous above with possible exception of midrib**
163 **Hairy beneath**
164 **Hairy above**
165 **With hairs or scales in axils only**
166 **Leaves and/or twigs with stellate** (with few to several branches or arms which arise from a central point) **or forked hairs**
167 **Leaf surface obscured by hairs or scales**
168 **Leaves and/or twigs not glandular, nor scaly nor armed**
169 **Resinous** (having a sticky exudate)
170 **Stalked glandular-hairy**
171 **With sessile glands or scale dots above**
172 **With sessile glands or scale dots beneath**
173 **Leaf hairs rough or scabrous**
174 **Leaf hairs appressed** (pressed flat against leaf blade)
175 **Leaf hairs short, curved or kinky**
176 **Leaf hairs short, straight**
177 **Leaf hairs long, straight or kinky**
178 **Mealy** (clothed with granular flakes)
179 **Cobwebby** (floccose hyphae-like mesh where individual hairs cannot be seen)
180 **Tomentose** (covered with dense, interwoven wooly hair)
181 **With red, brown, or yellow scales**
182 **With silver scales**
183 **Much lighter beneath** (eg. Silver Maple and Sweetbay)
184 **Large spotted or mottled**
330 **Hair red, tan, or brown (leaf or twig)**
331 **Hair golden (leaf or twig)**

*LEAF/LEAFLET BLADE SHAPE (the leaflet shape in compound leaves)

185 **Cruciform** (cross-shaped)
186 **Elliptical** (broadest point midway between ends and width about one-half length)
187 **Falcate** (sickle-shaped)
188 **Lanceolate** (broadened at base and tapering toward apex)
189 **Linear** (narrow and flat, with sides parallel)
190 **Oblanceolate** (inversely lanceolate, with broader half above middle and tapering toward base)
191 **Oblong** (two to four times longer than wide with sides parallel)
192 **Obovate** (inversely ovate, with broadest half above middle and narrower toward base)
193 **Orbicular** (round)
194 **Ovate** (egg-shaped, widest below middle)
195 **Reniform** (kidney-shaped)
196 **Spathulate** (spatula-like, rounded above and gradually narrowed to base)
197 **Terete** (cylindrical, round in cross section)
198 **Triangular**
199 **Broadest above middle**
200 **Broadest at middle**
201 **Broadest below middle**
202 **Broader than long**
203 **1 to 1.25 times longer than broad**
204 **1.25 to 3.25 times longer than broad**
205 **3.25 to 5 times longer than broad**
206 **5 or more times longer than broad**
207 **Grooved ventrally**

LEAF/LEAFLET BLADE SIZE

Note: In a compound leaf, length is measured from the petiole apex to the leaf (terminal leaflet) apex; width is measured as the maximum extent of the opposing leaflet apices.

208 **Leaf blade length <0.3 cm**
209 **Leaf blade length 0.3-1 cm**
210 **Leaf blade length 1-3 cm**
211 **Leaf blade length 3-5 cm**
212 **Leaf blade length 5-10 cm**
213 **Leaf blade length 10-20 cm**
214 **Leaf blade length >20 cm**
215 **Leaf blade width <0.1 cm**
216 **Leaf blade width 0.1-0.4 cm**
217 **Leaf blade width 0.4-1 cm**
218 **Leaf blade width 1-3 cm**
219 **Leaf blade width 3-6 cm**
220 **Leaf blade width >6 cm**
221 **Leaflet blade length <0.3 cm**
222 **Leaflet blade length 0.3-1 cm**
223 **Leaflet blade length 1-3 cm**
224 **Leaflet blade length 3-5 cm**
225 **Leaflet blade length 5-10 cm**
226 **Leaflet blade length >10 cm**
227 **Leaflet blade width <0.1 cm**
228 **Leaflet blade width 0.1-0.4 cm**
229 **Leaflet blade width 0.4-1 cm**
230 **Leaflet blade width 1-3 cm**
231 **Leaflet blade width 3-6 cm**
232 **Leaflet blade width >6 cm**

LEAF/LEAFLET BLADE BASE

233 **Peltate** (petiole attached near center on underside of blade)
234 **Decurrent on stem** (extend downward)
235 **Auriculate** (ear-shaped)
236 **Attenuate** (gradually narrowed to a long point)
237 **Clasping stem**
238 **Leaf base or petiole connate** (united)
239 **Cordate** (heart-shaped with notch at base and ovate in general outline)
240 **Cuneate** (wedge shaped, with narrower part at point of attachment)
241 **Hastate** (arrowhead-shaped with the basal lobes turned out)
242 **Rounded**
243 **Truncate** (cut squarely across)
244 **Oblique** (blade halves join petiole at dissimilar points)
245 **Unequal** (asymmetrical halves, with one half much larger than the other)

LEAF/LEAFLET BLADE TIP
246 **Acute** (margins form a terminal angle of 45-90 degrees)
247 **Acuminate** (margins form a terminal angle of <45 degrees)
248 **Leaf tip or lobes mucronate** (with a short, small abrupt tip)
249 **Notched**
250 **Obtuse** (margins forming a terminal angle >90 degrees)
251 **Truncate** (cut straight across)

LEAF/LEAFLET VENATION
Note: Included are major, often elevated veins on one side of leaf, extending from midrib nearly or to the margin. Not included are small apical veins or trivial veins.
252 **Lateral veins 0**
253 **Lateral veins 1-4**
254 **Lateral veins 5-9**
255 **Lateral veins 10+**
256 **Veins parallel**
257 **Basal veins 1**
258 **Basal veins 2-3**
259 **Basal veins 4-5**
260 **Basal veins 6+**

LEAF PETIOLE/STIPULE
261 **Petiole length <1 mm**
262 **Petiole length 1-4 mm**
263 **Petiole length 4-10 mm**
264 **Petiole length 10-30 mm**
265 **Petiole length >30 mm**
266 **Petiole red virtually throughout**
267 **Petiole hollow at base** (completely surrounds bud)
268 **Petiole jointed** (appears to be fused or fractured at apex, middle or base)
269 **Petiole ciliate** (fringed with fine hairs)
270 **Petiole glandular-hairy**
271 **Petiole apex glandular** (with conspicuous glands where blade and petiole intersect either dorsally or ventrally)
272 **Petiole/rachis** (central axis of a compound leaf) **winged**
273 **Petiole/rachis flat**
274 **Petiole longer than leaf blade**
275 **Stipule fimbriate**

PETIOLE LATEX
276 **Yellow latex** (thickened sap)
277 **White latex**

NEEDLE CONDITION
278 **Leaves needle- or scale-like**
279 **Grooved above**
280 **Not grooved above**
281 **Flat or half-round (rotate between the index finger and thumb)**
282 **3-4 angled (rotate between the index finger and thumb)**
283 **Strongly twisted (>1 spiral from base to apex)**
284 **Straight**
285 **Yellow/light green**
286 **Blue/dark green**
287 **Widely spread apically (forming a conspicuous V)**
288 **Growing from trunk**
289 **Brittle (easily snapped when flexed to the maximum)**

TENDRILS
290 **Present**
291 **Forked**
292 **1**
293 **2-3**
294 **4-5**
295 **6+**
296 **Opposite every third leaf on stem or on upper stem only**
297 **Opposite all stem leaves**
298 **Terminating in disk-like appendages**

STEM/BARK CONDITION

166 **Leaves and/or twigs with stellate** (with few to several branches or arms which arise from a central point) **or forked hairs**
168 **Leaves and/or twigs not glandular, nor scaly nor armed**
299 **Spur shoots present** (a short shoot or spur on which flowers and fruits or leaves are borne)
300 **Twig zig-zag**
301 **Twig in flat fans or palm-like sprays**
302 **Twig angled** (more than 2 angles)
303 **Twig round**
304 **Twig winged** (with a conspicuous membrane extending in 2 or more planes along the stem)
305 **Twig thick** (>2 mm in diameter 4 inches down the twig from apex)
306 **Twig slender** (<2 mm in diameter 4 inches down the twig from apex)
307 **Twig minutely grooved or ridged**
308 **Twig jointed** (appearing to have joints at nodes, internodes or both)
309 **Twig green** (fall or winter condition)
310 **Twig gray, brown, or black** (fall or winter condition)
311 **Twig red, purple, or orange** (fall or winter condition)
312 **Twig yellow, white, or beige** (fall or winter condition)
313 **Stem fleshy** (succulent)
314 **Stem hollow at nodes and/or internodes**
315 **Pith continuous** (with an uninterrupted solid core)
316 **Pith diaphragmed** (with a solid core and distinct dividing membranes or partitions)
317 **Pith chambered** (only distinct partitions without a solid core)
318 **Pith angled in cross section**
319 **Pith round in cross section**
320 **Pith light brown to salmon in second year or older wood**
321 **Pith dark chocolate brown in second year or older wood**
322 **Pith white or green in second year or older wood**
323 **Inner bark yellow**
324 **Bark exfoliating** (peeling in thin layers, shreds, or plates)
325 **Bark white or yellow**
326 **Bark peeling horizontally**
327 **Branch/trunk color striped** (marked with fine vertical colored lines, eg. white on green, black on gray, or white on brown)

*STEM VESTITURE

328 **Twig hairy**
329 **Twig hairy in vertical lines**
330 **Hair red, tan, or brown (leaf or twig)**
331 **Hair golden (leaf or twig)**
332 **Twig glabrous** (without hairs)
333 **Twig glaucous** (covered with a whitened bloom or smooth waxy coating)
334 **Twig stalked glandular-hairy**
335 **Twig sessile glandular or scale dotted**
336 **Twig with red, brown, or yellow scales**
337 **Twig with silver scales**
338 **Twig scurfy** (clothed with small bran-like flakes)
339 **Twig resinous** (having a sticky exudate)
340 **Twig papillose** (bearing minute, nipple-shaped or blister-like projections)

FLOWERING DURATION

341 **Flowers precocious** (flowers appearing before leaves)
342 **Flowers coetaneous** (flowers appearing as leaves expand, concurrent with leaf development)
343 **Flowers serotinous** (flowers appearing after leaves are mature)

*FLOWER COLOR

344 **Green**
345 **White**
346 **Yellow**
347 **Deep to lilac purple or lavender**
348 **Magenta,rose, or pink**
349 **Red**
350 **Orange**
351 **Maroon/brown**
352 **Blue**

FLOWER/FRUIT/CONE POSITION

353 **Axillary**
354 **Terminal** (at branch tips)

FLOWER FUSION AND NUMBER

355 **Flowers solitary**
356 **Flowers in pairs**
357 **Flowers in clusters of 3-5**
358 **Flowers in clusters of 6+**
359 **Flower petals not fused to fused 5%**
360 **Flower petals 5-20% fused**
361 **Flower petals 20-50% fused**
362 **Flower petals 50-75% fused**
363 **Flower petals 75-100% fused**
364 **Petals 0**
365 **Petals 1-2**
366 **Petals 3**
367 **Petals 4**
368 **Petals 5**
369 **Petals 6+**
370 **Sepals 0**
371 **Sepals 1-2**
372 **Sepals 3**
373 **Sepals 4**
374 **Sepals 5**
375 **Sepals 6+**
376 **Stamens 1**
377 **Stamens 2**
378 **Stamens 3**
379 **Stamens 4**
380 **Stamens 5**
381 **Stamens 6**
382 **Stamens 7-8**
383 **Stamens 9-11**
384 **Stamens 12-20**
385 **Stamens 21+**
386 **Stigmas 0**
387 **Stigmas 1**
388 **Stigmas 2**
389 **Stigmas 3**
390 **Stigmas 4**
391 **Stigmas 5**
392 **Stigmas 6+**
393 **Stamens included** (at or below the apex of corolla)
394 **Stamens excluded** (exserted significantly beyond the corolla apex)

FLOWER FRAGRANCE

395 **Not fragrant**
396 **Fragrant** (pleasant)
397 **Fetid** (stinking, unpleasant)

INFLORESCENCE TYPE/FLOWER SIZE OR SHAPE

398 **Flower bracts conspicuous** (eg. Flowering Dogwood)
399 **Flowers in heads** (dense sessile aggregate of flowers, eg. Dandelion)
400 **Flowers in spikes** (an unbranched, elongate inflorescence with sessile flowers)
401 **Flowers in corymbs** (a flat-topped or convex raceme with lower pedicels elongated and rachis shortened)
402 **Flowers in panicles** (a branched elongate inflorescence with two or more pedicelled flowers per branch)
403 **Flowers in racemes** (an elongated inflorescence with pedicelled flowers, eg. Cardinal Flower)
404 **Flowers in cymes** (a determinate inflorescence, of various shapes or degrees of branching, but the oldest flower is always on the end of the branch)
405 **Flowers in umbels** (a flat or convex flower cluster in which the pedicels arise from a common point, like the rays of an umbrella, eg. Queen Anne's Lace)
406 **Flowers in catkins** (a scaly deciduous spike, eg. Alder, Birch)
407 **Corolla length <2 mm**
408 **Corolla length 2-5 mm**
409 **Corolla length 5-10 mm**
410 **Corolla length 10-15 mm**
411 **Corolla length >15 mm**
412 **Flowers strongly bilabiate** (appearing with two lips, eg. mints)

*FRUIT TEXTURE

413 **Fleshy** (soft and mushy, eg. peach)
414 **Dry/leathery** (eg. Hickory, Walnut)
415 **Eciliate** (without cilia) **winged** (eg. Maple)
416 **Ciliate** (fringed with fine marginal hairs) **winged** (eg. American Elm)
417 **Falcate** (sickle-shaped) **/spiral** (eg. Honey Locust)

*FRUIT COLOR

418 **Red/pink**
419 **White**
420 **Black**
421 **Orange**
422 **Yellow**
423 **Blue**
424 **Purple/lavender**
425 **Green**
426 **Gray**
427 **Brown**

*FRUIT VESTITURE

428 Stalked glandular-hairy
429 Sessile glandular
430 Eglandular-hairy
431 Red or brown hairy
432 Scurfy (with small bran-like scales) **/scaly**
433 Glabrous (without hairs)
434 Glaucous
435 Plumose (feathery) **or with a pappus** (group of bristles, hairs, awns or scale-like structures at apex of achenes)
436 Pedicels with stalked glandular hairs
437 Pedicels with sessile glandular hairs
438 Pedicels eglandular

FRUIT SIZE

439 Length <0.3 cm
440 Length 0.3-1 cm
441 Length 1-2 cm
442 Length 2-3 cm
443 Length 3-7 cm
444 Length >7 cm
445 Width <0.2 cm
446 Width 0.2-0.5 cm
447 Width 0.5-1 cm
448 Width 1-2 cm
449 Width 2-3 cm
450 Width >3 cm
451 Fruit stalk longer than leaf petiole

CONE CONDITION
452 Cones present
453 Length <1 cm
454 Length 1-3 cm
455 Length 3-5 cm
456 Length 5-10 cm
457 Length >10 cm
458 Width <1 cm
459 Width 1-3 cm
460 Width 3-5 cm
461 Width >5 cm
462 Longer than wide
463 As long as wide
464 Wider than long
465 Erect
466 Pendent (hanging down)
467 Straight
468 Curved
469 Long-stalked (>0.5 cm)
470 Sessile/short-stalked
471 Scales thick
472 Scales thin
473 Scales longer than wide
474 Scales wider than long
475 Scales apically round
476 Scales apically wedge-shaped
477 Scale prickle long
478 Scale prickle short
479 Scale unarmed
480 Scale margin smooth
481 Scale margin ragged
482 Scale deciduous
483 Bract longer than scale
484 Bract shorter than scale
485 Bract armed
486 Bract unarmed
487 Blue/purple (at maturity)
488 Red/brown/yellow (at maturity)
489 Green (at maturity)

*ARMAMENT

490 **Inflorescence armed** (pointed structure that can penetrate the skin on or within floral unit including the pedicel)
491 **Stem armed**
492 **Leaf armed**
493 **Fruit armed**
494 **Stem with bristly thorns or sharp piercing hairs**
495 **Internode/node spines similar** (in size or shape)
496 **Internode/node spines differ**
497 **Twig apically thorny** (a sharp-pointed, stiff woody body derived from a modified branch)
498 **Leaf margin/apex armed**
499 **Armament thick at base** (3/4 as wide as long)
500 **Armament thin at base** (1/2 or less as wide as long)
501 **Armament branched**
502 **Armament simple** (not branched)
503 **Armament significantly curved downward or hooked** (similar to a cock spur or the letter C)
504 **Armament straight or nearly straight with only the slightest arc**

*PLANT FRAGRANCE

395 **Flowers not fragrant**
396 **Flowers fragrant** (pleasant)
397 **Flowers fetid** (stinking, unpleasant)
505 **Stem/leaf fragrant** (sweet or pleasant odor)
506 **Stem/leaf fetid** (foul, stinking, or disagreeable odor)
507 **Roots licorice scented**

ROOTS

508 **Prop roots** (eg. Red Mangrove or Corn)
509 **Aerial roots** (fibrous adventitious roots)

Woody Key, 830 taxa.

8	Abies amabilis
9	Abies balsamea
10	Abies fraseri
11	Abies lasiocarpa
12	Abies magnifica
352	Acacia greggii
353	Acacia minuta
41	Acer circinatum
42	Acer glabrum
43	Acer macrophyllum
44	Acer negundo
45	Acer pensylvanicum
46	Acer rubrum
47	Acer saccharinum
48	Acer saccharum
49	Acer spicatum
354	Aeschynomene sensitiva
440	Aesculus glabra
441	Aesculus pavia
442	Aesculus sylvatica
261	Agarista populifolia
768	Ailanthus altissima
355	Alhagi maurorum
199	Allenrolfea occidentalis
132	Alnus glutinosa
133	Alnus incana
134	Alnus maritima
135	Alnus oblongifolia
136	Alnus rhombifolia
137	Alnus rubra
138	Alnus serrulata
139	Alnus viridis
562	Amelanchier alnifolia
563	Amelanchier arborea
564	Amelanchier bartramiana
565	Amelanchier canadensis
566	Amelanchier obovalis
567	Amelanchier stolonifera
356	Amorpha californica
357	Amorpha fruticosa
358	Amorpha georgiana
359	Amorpha herbacea
360	Amorpha nana
361	Amorpha nitens
362	Amorpha paniculata
363	Amorpha roemeriana
815	Ampelopsis arborea
816	Ampelopsis cordata
262	Andromeda polifolia
241	Aniseia martinicensis

62	Annona glabra
85	Aralia spinosa
263	Arctostaphylos alpina
264	Arctostaphylos uva-ursi
159	Argusia gnaphalodes
568	Aronia arbutifolia
569	Aronia melanocarpa
96	Artemisia arbuscula
97	Artemisia cana
98	Artemisia lindleyana
99	Artemisia ludoviciana
100	Artemisia papposa
63	Asimina parviflora
64	Asimina pygmaea
65	Asimina reticulata
66	Asimina triloba
101	Aster carolinianus
200	Atriplex bonnevillensis
201	Atriplex canescens
202	Atriplex falcata
203	Atriplex fruticulosa
204	Atriplex griffithsii
205	Atriplex lentiformis
206	Atriplex parryi
207	Atriplex polycarpa
208	Atriplex spinifera
209	Atriplex torreyi
210	Atriplex tridentata
809	Avicennia germinans
102	Baccharis angustifolia
103	Baccharis dioica
104	Baccharis douglasii
105	Baccharis emoryi
106	Baccharis glomeruliflora
107	Baccharis halimifolia
108	Baccharis neglecta
109	Baccharis salicifolia
110	Baccharis salicina
111	Baccharis sarothroides
112	Baccharis sergiloides
113	Baccharis wrightii
129	Batis maritima
265	Befaria racemosa
130	Berberis thunbergii
131	Berberis vulgaris
551	Berchemia scandens
140	Betula alleghaniensis
141	Betula lenta
142	Betula nana
143	Betula nigra
144	Betula occidentalis
145	Betula papyrifera

146	Betula populifolia
147	Betula pubescens
148	Betula pumila
153	Bignonia capreolata
114	Borrichia arborescens
115	Borrichia frutescens
116	Brickellia californica
238	Bucida buceras
364	Caesalpinia bonduc
365	Caesalpinia major
810	Callicarpa americana
811	Callicarpa dichotoma
266	Calluna vulgaris
161	Calycanthus floridus
162	Calycanthus occidentalis
493	Calycocarpum lyonii
154	Campsis radicans
149	Carpinus caroliniana
450	Carya aquatica
451	Carya cordiformis
452	Carya glabra
453	Carya illinoinensis
454	Carya laciniosa
455	Carya myrisiticiformis
456	Carya ovalis
457	Carya ovata
267	Cassiope mertensiana
268	Cassiope tetragona
193	Casuarina equisetifolia
194	Casuarina glauca
155	Catalpa bignonioides
156	Catalpa speciosa
69	Catharanthus roseus
252	Cayaponia racemosa
552	Ceanothus sanguineus
195	Celastrus orbiculata
196	Celastrus scandens
800	Celtis laevigata
801	Celtis occidentalis
667	Cephalanthus occidentalis
668	Cephalanthus salicifolius
366	Cercis canadensis
1	Chamaecyparis lawsoniana
2	Chamaecyparis nootkatensis
3	Chamaecyparis thyoides
269	Chamaedaphne calyculata
346	Chamaesyce mesembrianthemifolia
157	Chilopsis linearis
519	Chionanthus virginicus
117	Chrysoma pauciflosculosa
467	Cinnamomum camphora
817	Cissus trifoliata

674	Citrus aurantium
542	Clematis addisonii
543	Clematis baldwinii
544	Clematis catesbyana
545	Clematis crispa
546	Clematis glaucophylla
547	Clematis ligusticifolia
548	Clematis pitcheri
549	Clematis terniflora
812	Clerodendrum philippinum
220	Clethra alnifolia
253	Cliftonia monophylla
221	Clusia rosea
540	Coccoloba uvifera
494	Cocculus carolinus
553	Colubrina asiatica
239	Conocarpus erectus
464	Conradina verticillata
242	Cornus amomum
243	Cornus asperifolia
244	Cornus canadensis
245	Cornus drummondii
246	Cornus florida
247	Cornus foemina
248	Cornus glabrata
249	Cornus sericea
250	Cornus sessilis
251	Cornus suecica
150	Corylus americana
151	Corylus cornuta
570	Crataegus aestivalis
571	Crataegus berberifolia
572	Crataegus brachyacantha
573	Crataegus crus-galli
574	Crataegus douglasii
575	Crataegus erythrocarpa
576	Crataegus marshallii
577	Crataegus mollis
578	Crataegus opaca
579	Crataegus phaenopyrum
580	Crataegus spathulata
581	Crataegus texana
582	Crataegus viridis
254	Cyrilla racemiflora
367	Dalbergia ecastaphylla
368	Dalea carnea
444	Decumaria barbara
67	Deeringothamnus pulchellus
68	Deeringothamnus rugelii
369	Desmanthus virgatus
370	Dioclea multiflora
255	Diospyros virginiana

764	Diplacus parviflorus
796	Dirca occidentalis
797	Dirca palustris
583	Dryas drummondii
256	Elaeagnus angustifolia
257	Elaeagnus commutata
259	Empetrum eamesii
260	Empetrum nigrum
270	Erica tetralix
669	Ernodea littoralis
347	Euphorbia curtisii
197	Evonymus americana
198	Evonymus atropurpurea
395	Fagus grandifolia
496	Ficus aurea
497	Ficus citrifolia
520	Forestiera acuminata
521	Forestiera ligustrina
522	Forestiera pubescens
436	Fothergilla gardenii
554	Frangula alnus
555	Frangula betulifolia
556	Frangula caroliniana
557	Frangula purshiana
417	Frankenia palmeri
418	Frankenia salina
523	Fraxinus americana
524	Fraxinus berlandieriana
525	Fraxinus caroliniana
526	Fraxinus latifolia
527	Fraxinus nigra
528	Fraxinus pennsylvanica
529	Fraxinus profunda
530	Fraxinus velutina
271	Gaultheria hispidula
272	Gaultheria humifusa
273	Gaultheria ovatifolia
274	Gaultheria procumbens
275	Gaylussacia baccata
276	Gaylussacia dumosa
277	Gaylussacia frondosa
278	Gaylussacia mosieri
476	Gelsemium rankinii
477	Gelsemium sempervirens
371	Gleditsia aquatica
372	Gleditsia triacanthos
795	Gordonia lasianthus
118	Grindelia humilis
670	Guettarda scabra
783	Halesia carolina
784	Halesia diptera
437	Hamamelis vernalis

438	Hamamelis virginiana
279	Harrimanella stelleriana
485	Hibiscus grandiflorus
486	Hibiscus tiliaceus
443	Hippocratea volubilis
445	Hydrangea arborescens
446	Hydrangea paniculata
222	Hypericum crux-andreae
223	Hypericum densiflorum
224	Hypericum edisonianum
225	Hypericum exile
226	Hypericum fasciculatum
227	Hypericum galioides
228	Hypericum hypericoides
229	Hypericum kalmianum
230	Hypericum microsepalum
231	Hypericum myrtifolium
232	Hypericum nitidum
233	Hypericum nudiflorum
234	Hypericum prolificum
235	Hypericum sphaerocarpum
236	Hypericum tetrapetalum
73	Ilex amelanchier
74	Ilex cassine
75	Ilex coriacea
76	Ilex decidua
77	Ilex glabra
78	Ilex laevigata
79	Ilex longipes
80	Ilex myrtifolia
81	Ilex opaca
82	Ilex verticillata
83	Ilex vomitoria
448	Illicium floridanum
449	Illicium parviflorum
373	Indigofera suffruticosa
119	Isocoma acradenia
420	Itea virginica
120	Iva axillaris
121	Iva frutescens
122	Iva hayesiana
123	Iva imbricata
447	Jamesia americana
458	Juglans californica
459	Juglans cinerea
460	Juglans hindsii
461	Juglans major
462	Juglans microcarpa
463	Juglans nigra
4	Juniperus horizontalis
5	Juniperus virginiana
280	Kalmia angustifolia

281	Kalmia carolina
282	Kalmia cuneata
283	Kalmia hirsuta
284	Kalmia latifolia
285	Kalmia microphylla
286	Kalmia polifolia
211	Kochia americana
212	Kochia californica
240	Laguncularia racemosa
813	Lantana camara
13	Larix laricina
14	Larix occidentalis
287	Ledum glandulosum
288	Ledum groenlandicum
289	Ledum palustre
290	Leiophyllum buxifolium
475	Leitneria floridana
374	Lespedeza cuneata
375	Leucaena leucocephala
291	Leucothoe axillaris
292	Leucothoe davisiae
293	Leucothoe racemosa
294	Leucothoe recurva
531	Ligustrum sinense
532	Ligustrum vulgare
539	Linanthus nuttallii
468	Lindera benzoin
469	Lindera melissifolia
470	Lindera subcoriacea
163	Linnaea borealis
814	Lippia alba
439	Liquidambar styraciflua
480	Liriodendron tulipifera
471	Litsea aestivalis
164	Lonicera caerulea
165	Lonicera canadensis
166	Lonicera conjugialis
167	Lonicera dioica
168	Lonicera hirsuta
169	Lonicera involucrata
170	Lonicera japonica
171	Lonicera morrowii
172	Lonicera oblongifolia
173	Lonicera sempervirens
174	Lonicera tatarica
175	Lonicera utahensis
584	Luetkea pectinata
777	Lycium carolinianum
295	Lyonia ferruginea
296	Lyonia fruticosa
297	Lyonia ligustrina
298	Lyonia lucida

299	Lyonia mariana
478	Lythrum alatum
124	Machaeranthera carnosa
498	Maclura pomifera
481	Magnolia fraseri
482	Magnolia grandiflora
483	Magnolia tripetala
484	Magnolia virginiana
487	Malacothamnus abbottii
585	Malus fusca
237	Mammea americana
53	Mangifera indica
509	Melaleuca quinquenervia
781	Melochia corchorifolia
782	Melochia pyramidata
495	Menispermum canadense
300	Menziesia ferruginea
301	Menziesia pilosa
54	Metopium toxiferum
376	Mimosa malacophylla
377	Mimosa pigra
378	Mimosa pudica
192	Minuartia obtusiloba
465	Monardella odoratissima
671	Morinda citrifolia
499	Morus alba
500	Morus microphylla
501	Morus rubra
502	Myrica californica
503	Myrica cerifera
504	Myrica gale
505	Myrica hartwegii
506	Myrica heterophylla
507	Myrica inodora
508	Myrica pensylvanica
84	Nemopanthus mucronatus
479	Nesaea salicifolia
778	Nicotiana glauca
50	Nolina atopocarpa
515	Nyssa aquatica
516	Nyssa ogeche
517	Nyssa sylvatica
534	Oenothera organensis
86	Oplopanax horridus
160	Opuntia stricta
533	Osmanthus americanus
152	Ostrya virginiana
302	Oxydendrum arboreum
672	Paederia foetida
379	Parkinsonia aculeata
818	Parthenocissus quinquefolia
819	Parthenocissus vitacea

535	Passiflora edulis
765	Paulownia tomentosa
488	Pavonia paludicola
766	Penstemon lyallii
767	Penstemon serrulatus
70	Pentalinon luteum
586	Pentaphylloides floribunda
472	Persea borbonia
303	Phyllodoce empetriformis
304	Phyllodoce glanduliflora
587	Physocarpus capitatus
588	Physocarpus monogynus
589	Physocarpus opulifolius
15	Picea engelmannii
16	Picea glauca
17	Picea mariana
18	Picea pungens
19	Picea rubens
20	Picea sitchensis
305	Pieris phillyreifolia
21	Pinus banksiana
22	Pinus contorta
23	Pinus elliottii
24	Pinus glabra
25	Pinus monticola
26	Pinus palustris
27	Pinus ponderosa
28	Pinus resinosa
29	Pinus rigida
30	Pinus serotina
31	Pinus strobus
32	Pinus taeda
380	Pithecellobium unguis-cati
802	Planera aquatica
536	Platanus occidentalis
537	Platanus racemosa
538	Platanus wrightii
125	Pluchea odorata
126	Pluchea sericea
678	Populus angustifolia
679	Populus balsamifera
680	Populus deltoides
681	Populus fremontii
682	Populus grandidentata
683	Populus heterophylla
684	Populus tremuloides
541	Primula suffrutescens
381	Prosopis pubescens
382	Prosopis velutina
590	Prunus alleghaniensis
591	Prunus americana
592	Prunus nigra

593	Prunus pensylvanica
594	Prunus serotina
595	Prunus virginiana
87	Pseudophoenix sargentii
510	Psidium cattleianum
511	Psidium guajava
675	Ptelea trifoliata
759	Pyrularia pubera
396	Quercus alba
397	Quercus bicolor
398	Quercus falcata
399	Quercus imbricaria
400	Quercus laurifolia
401	Quercus lobata
402	Quercus lyrata
403	Quercus macrocarpa
404	Quercus michauxii
405	Quercus muehlenbergii
406	Quercus nigra
407	Quercus oglethorpensis
408	Quercus palustris
409	Quercus phellos
410	Quercus prinoides
411	Quercus prinus
412	Quercus rubra
413	Quercus shumardii
414	Quercus stellata
415	Quercus texana
416	Quercus virginiana
673	Randia aculeata
71	Rhabdadenia biflora
558	Rhamnus alnifolia
559	Rhamnus cathartica
560	Rhamnus lanceolata
88	Rhapidophyllum hystrix
561	Rhizophora mangle
306	Rhododendron albiflorum
307	Rhododendron arborescens
308	Rhododendron atlanticum
309	Rhododendron canadense
310	Rhododendron canescens
311	Rhododendron chapmanii
312	Rhododendron lapponicum
313	Rhododendron maximum
314	Rhododendron oblongifolium
315	Rhododendron occidentale
316	Rhododendron periclymenoides
317	Rhododendron prinophyllum
318	Rhododendron vaseyi
319	Rhododendron viscosum
512	Rhodomyrtus tomentosus
55	Rhus copallina

56	Rhus trilobata
421	Ribes acerifolium
422	Ribes americanum
423	Ribes aureum
424	Ribes bracteosum
425	Ribes cereum
426	Ribes divaricatum
427	Ribes glandulosum
428	Ribes hirtellum
429	Ribes hudsonianum
430	Ribes inerme
431	Ribes lacustre
432	Ribes oxyacanthoides
433	Ribes triste
434	Ribes viscosissimum
435	Ribes wolfii
348	Ricinus communis
383	Robinia pseudoacacia
596	Rosa acicularis
597	Rosa arkansana
598	Rosa blanda
599	Rosa bracteata
600	Rosa californica
601	Rosa carolina
602	Rosa gymnocarpa
603	Rosa micrantha
604	Rosa multiflora
605	Rosa nitida
606	Rosa nutkana
607	Rosa palustris
608	Rosa pisocarpa
609	Rosa rugosa
610	Rosa setigera
611	Rosa virginiana
612	Rosa woodsii
89	Roystonea elata
613	Rubus allegheniensis
614	Rubus alumnus
615	Rubus amnicola
616	Rubus apogaeus
617	Rubus arcticus
618	Rubus argutus
619	Rubus arizonensis
620	Rubus arvensis
621	Rubus baileyanus
622	Rubus bartonianus
623	Rubus cuneifolius
624	Rubus discolor
625	Rubus flagellaris
626	Rubus floricomus
627	Rubus hispidoides
628	Rubus hispidus

629	Rubus hypolasius
630	Rubus idaeus
631	Rubus laciniatus
632	Rubus lawrencei
633	Rubus longii
634	Rubus missouricus
635	Rubus multiformis
636	Rubus oklahomus
637	Rubus paganus
638	Rubus parviflorus
639	Rubus plus
640	Rubus probabilis
641	Rubus schoolcraftianus
642	Rubus semisetosus
643	Rubus setosus
644	Rubus sons
645	Rubus spectabilis
646	Rubus spectatus
647	Rubus stipulatus
648	Rubus subtractus
649	Rubus suus
650	Rubus tardatus
651	Rubus trivialis
652	Rubus uvidus
653	Rubus vigil
654	Rubus vitifolius
655	Rubus wheeleri
40	Ruellia nudiflora
90	Sabal minor
91	Sabal palmetto
213	Salicornia virginica
685	Salix alaxensis
686	Salix alba
687	Salix amygdaloides
688	Salix arbusculoides
689	Salix arctica
690	Salix arctophila
691	Salix argyrocarpa
692	Salix athabascensis
693	Salix babylonica
694	Salix barclayi
695	Salix barrattiana
696	Salix bebbiana
697	Salix bonplandiana
698	Salix boothii
699	Salix brachycarpa
700	Salix breweri
701	Salix candida
702	Salix caroliniana
703	Salix chamissonis
704	Salix commutata
705	Salix cordata

706 Salix discolor
707 Salix drummondiana
708 Salix eastwoodiae
709 Salix eriocephala
710 Salix exigua
711 Salix farriae
712 Salix floridana
713 Salix fragilis
714 Salix fuscescens
715 Salix geyeriana
716 Salix glauca
717 Salix gooddingii
718 Salix hastata
719 Salix hookeriana
720 Salix humilis
721 Salix irrorata
722 Salix jepsonii
723 Salix lanata
724 Salix lasiolepis
725 Salix lemmonii
726 Salix lucida
727 Salix lutea
728 Salix melanopsis
729 Salix monochroma
730 Salix monticola
731 Salix myricoides
732 Salix myrtillifolia
733 Salix nigra
734 Salix orestera
735 Salix ovalifolia
736 Salix pedicellaris
737 Salix pellita
738 Salix petiolaris
739 Salix phlebophylla
740 Salix planifolia
741 Salix polaris
742 Salix pseudomonticola
743 Salix purpurea
744 Salix pyrifolia
745 Salix reticulata
746 Salix rotundifolia
747 Salix scouleriana
748 Salix sericea
749 Salix serissima
750 Salix sessilifolia
751 Salix setchelliana
752 Salix sitchensis
753 Salix sphenophylla
754 Salix taxifolia
755 Salix tweedyi
756 Salix vestita
757 Salix viminalis

758	Salix wolfii
466	Salvia lycioides
176	Sambucus canadensis
177	Sambucus cerulea
178	Sambucus racemosa
760	Sapindus saponaria
349	Sapium sebiferum
214	Sarcobatus vermiculatus
215	Sarcocornia utahensis
94	Sarcostemma clausum
95	Sarcostemma cynanchoides
473	Sassafras albidum
419	Scaevola plumieri
57	Schinus terebinthifolius
350	Sebastiania fruticosa
127	Senecio salignus
384	Senna alata
385	Senna pendula
386	Senna surattensis
92	Serenoa repens
387	Sesbania drummondii
388	Sesbania emerus
389	Sesbania punicea
390	Sesbania sericea
258	Shepherdia canadensis
489	Sida rhombifolia
761	Sideroxylon lanuginosum
762	Sideroxylon lycioides
763	Sideroxylon reclinatum
769	Smilax auriculata
770	Smilax bona-nox
771	Smilax glauca
772	Smilax laurifolia
773	Smilax rotundifolia
774	Smilax smallii
775	Smilax tamnoides
776	Smilax walteri
779	Solanum carolinense
128	Solidago multiradiata
391	Sophora tomentosa
656	Sorbus americana
657	Sorbus decora
658	Sorbus scopulina
659	Spiraea alba
660	Spiraea betulifolia
661	Spiraea douglasii
662	Spiraea japonica
663	Spiraea salicifolia
664	Spiraea stevenii
665	Spiraea tomentosa
666	Spiraea virginiana
780	Staphylea trifolia

351	Stillingia aquatica
785	Styrax americanus
786	Styrax grandifolius
787	Styrax platanifolius
216	Suaeda californica
217	Suaeda conferta
218	Suaeda moquinii
219	Suaeda suffrutescens
179	Symphoricarpos albus
180	Symphoricarpos orbiculatus
181	Symphoricarpos oreophilus
788	Symplocos tinctoria
513	Syzygium cumini
514	Syzygium jambos
158	Tabebuia heterophylla
789	Tamarix africana
790	Tamarix aphylla
791	Tamarix chinensis
792	Tamarix gallica
793	Tamarix parviflora
794	Tamarix ramosissima
38	Taxodium distichum
39	Taxodium mucronatum
36	Taxus brevifolia
37	Taxus canadensis
492	Tetrazygia bicolor
490	Thespesia populnea
6	Thuja occidentalis
7	Thuja plicata
798	Tilia americana
58	Toxicodendron pubescens
59	Toxicodendron radicans
60	Toxicodendron rydbergii
61	Toxicodendron vernix
72	Trachelospermum difforme
392	Trifolium nanum
393	Trifolium parryi
676	Triphasia trifolia
33	Tsuga canadensis
34	Tsuga heterophylla
35	Tsuga mertensiana
799	Turnera ulmifolia
803	Ulmus alata
804	Ulmus americana
805	Ulmus crassifolia
806	Ulmus rubra
807	Ulmus serotina
808	Ulmus thomasii
474	Umbellularia californica
491	Urena lobata
320	Vaccinium angustifolium
321	Vaccinium arboreum

322	Vaccinium caesariense
323	Vaccinium cespitosum
324	Vaccinium corymbosum
325	Vaccinium crassifolium
326	Vaccinium darrowii
327	Vaccinium elliottii
328	Vaccinium erythrocarpum
329	Vaccinium formosum
330	Vaccinium fuscatum
331	Vaccinium macrocarpon
332	Vaccinium membranaceum
333	Vaccinium myrsinites
334	Vaccinium myrtilloides
335	Vaccinium myrtillus
336	Vaccinium ovalifolium
337	Vaccinium oxycoccos
338	Vaccinium scoparium
339	Vaccinium simulatum
340	Vaccinium stamineum
341	Vaccinium tenellum
342	Vaccinium uliginosum
343	Vaccinium virgatum
344	Vaccinium vitis-idaea
182	Viburnum acerifolium
183	Viburnum dentatum
184	Viburnum edule
185	Viburnum lantanoides
186	Viburnum lentago
187	Viburnum nudum
188	Viburnum obovatum
189	Viburnum plicatum
190	Viburnum prunifolium
191	Viburnum rufidulum
820	Vitis aestivalis
821	Vitis arizonica
822	Vitis californica
823	Vitis cinerea
824	Vitis labrusca
825	Vitis palmata
826	Vitis riparia
827	Vitis rotundifolia
828	Vitis rupestris
829	Vitis shuttleworthii
830	Vitis vulpina
93	Washingtonia filifera
394	Wisteria frutescens
550	Xanthorhiza simplicissima
518	Ximenia americana
51	Yucca aloifolia
52	Yucca gloriosa
677	Zanthoxylum clava-herculis
345	Zenobia pulverulenta

ASTER

General	Leaf	Flower/ Inflorescence	Fruit	Stem	Root
Geography 254–329	Position 40–44	Type 105–112	Color 211–214	Number 24–25	Type 5–10
Habit 1- 4 12–15	Type 37–39 45–52	Position/ Form 103–104 113–130	Shape 215–227	Size 29–32	
Duration 2–3	Vesture 18–23 78–86	Involucre 131–139	Vesture 228–235	Vesture/ Color 18–23 34–36	
Fragrance 11	Size 87–97	Phyllary 140–161	Pappus 236–248	Condition 26–28	
Latex 17	Number 53–54	Ray 162–184			
Arrangement 16	Shape 55–60	Disk 185–203			
	Apex/Base 61–63 67–71	Receptacle 204–210			
	Margin 64–66				
	Variation 72–77				
	Petiole 98–102				

322 Vaccinium caesariense
323 Vaccinium caespitosum
324 Vaccinium corymbosum
325 Vaccinium crassifolium
326 Vaccinium darrowii
327 Vaccinium elliottii
328 Vaccinium erythrocarpum
329 Vaccinium formosum
330 Vaccinium fuscatum
331 Vaccinium macrocarpon
332 Vaccinium membranaceum
333 Vaccinium myrsinites
334 Vaccinium myrtilloides
335 Vaccinium myrtillus
336 Vaccinium ovalifolium
337 Vaccinium oxycoccos
338 Vaccinium scoparium
339 Vaccinium simulatum
340 Vaccinium stamineum
341 Vaccinium tenellum
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343 Vaccinium virgatum
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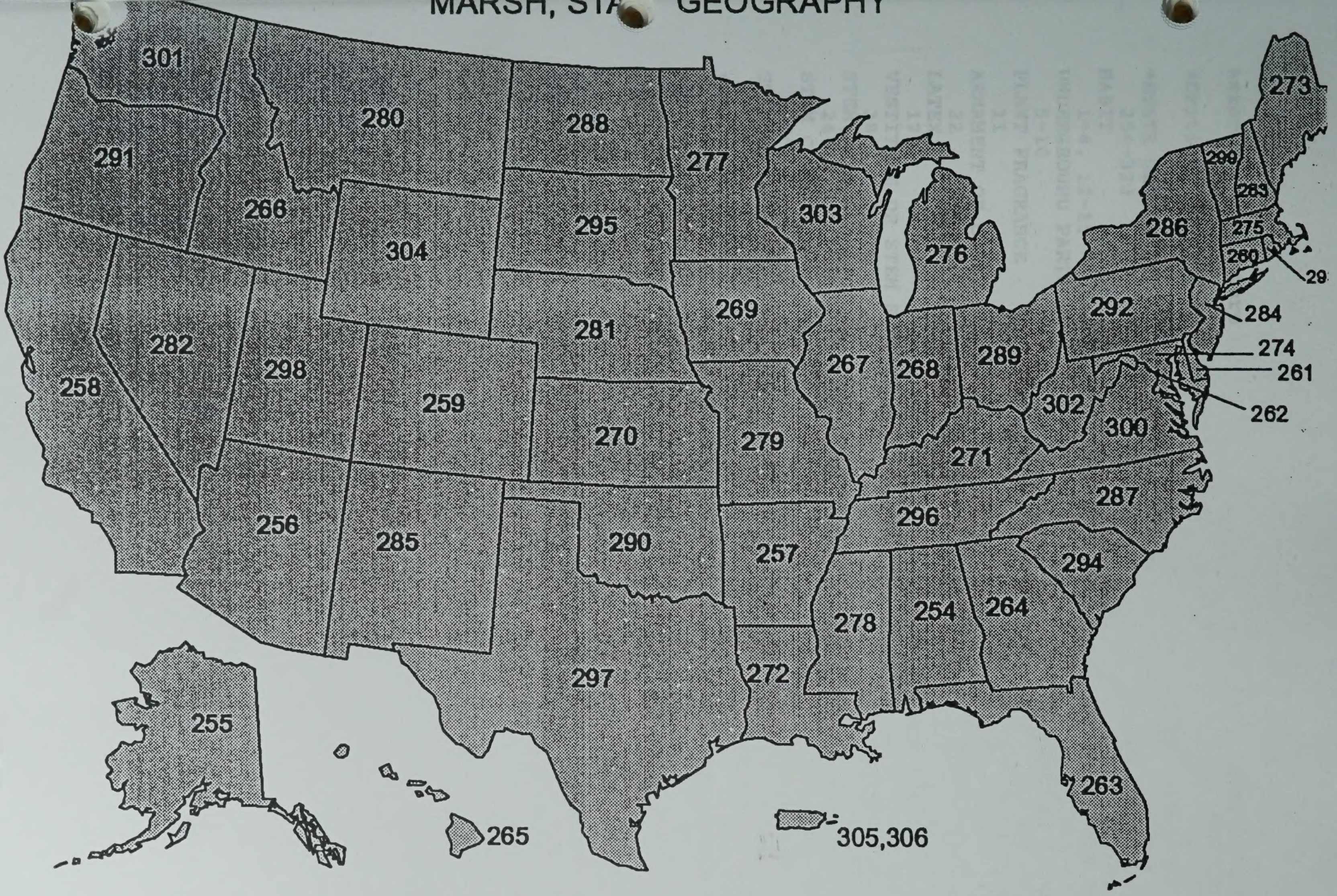
826 Vitis riparia
827 Vitis rotundifolia
828 Vitis rupestris
829 Vitis shuttleworthii
830 Vitis vulpina
91 Washingtonia filifera
884 Wisteria frutescens
360 Xanthorhiza simplicissima
916 Ximenia americana
61 Yucca aloifolia
58 Yucca gloriosa
497 Zanthoxylum clava-herculis
345 Zenobia pulverulenta

ASTER

General	Leaf	Flower/ Inflorescence	Fruit	Stem	Root
Geography 254–323	Position 40–44	Type 105–112	Color 211–214	Number 24–25	Type 5–10
Habit 1 4 12–15	Type 37–39 45–52	Position/ Form 103–104 113–126	Shape 215–227	Size 29–32	
Duration 2–3	Vestiture 18–23 76–86	Involucre 131–139	Vestiture 228–235	Vestiture/ Color 18–23 34–36	
Fragrance 11	Size 87–97	Phyllary 140–161	Pappus 236–249	Condition 26–28	
Latex 17	Number 53–54	Ray 162–184			
Armament 16	Shape 55–60	Disk 185–203			
	Apex/Base 61–63 67–71	Receptacle 204–210			
	Margin 64–66				
	Venation 72–75				
	Petiole 98–102				

MARSH, STA GEOGRAPHY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Aster Key Characters

*Critical Characters

*STATE GEOGRAPHY
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29-32
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45-52
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61-63
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64-66
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187-190
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191-197
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Aster Key, 323 Characters.

*Critical Characters

*STATE GEOGRAPHY

254	**Alabama**
255	**Alaska**
256	**Arizona**
257	**Arkansas**
258	**California**
259	**Colorado**
260	**Connecticut**
261	**Delaware**
262	**District of Columbia**
263	**Florida**
264	**Georgia**
265	**Hawaii**
266	**Idaho**
267	**Illinois**
268	**Indiana**
269	**Iowa**
270	**Kansas**
271	**Kentucky**
272	**Louisiana**
273	**Maine**
274	**Maryland**
275	**Massachusetts**
276	**Michigan**
277	**Minnesota**
278	**Mississippi**
279	**Missouri**
280	**Montana**
281	**Nebraska**
282	**Nevada**
283	**New Hampshire**
284	**New Jersey**
285	**New Mexico**
286	**New York**
287	**North Carolina**
288	**North Dakota**
289	**Ohio**
290	**Oklahoma**
291	**Oregon**
292	**Pennsylvania**
293	**Rhode Island**
294	**South Carolina**
295	**South Dakota**
296	**Tennessee**
297	**Texas**
298	**Utah**
299	**Vermont**
300	**Virginia**

301 Washington
302 West Virginia
303 Wisconsin
304 Wyoming
305 Puerto Rico
306 Virgin Islands
307 Alberta
308 British Columbia
309 Franklin
310 Keewatin
311 Labrador
312 MacKenzie
313 Manitoba
314 New Brunswick
315 Newfoundland
316 Nova Scotia
317 Ontario
318 Prince Edward Island
319 Quebec
320 Saskatchewan
321 Yukon Territory
322 Greenland (Denmark)
323 St. Pierre and Miquelon Islands (France)

HABIT

1 Shrubs (woody plant usually less than 4 meters tall and multiple branched at base)
2 Annual or biennial (living for one or two years) herbs
3 Perennial (living several to many seasons) herbs
4 Mat-forming or colonial (in clumps)
12 Thistle, broom-like, or vine-like
13 Scapose or subscapose (a naked flowering stem rising from the ground)
14 Stolons (a shoot that bends to the ground and takes root or a horizontal stem at or below the surface of the ground that gives rise to a new plant at the tip) trailing, ascending, or underground
15 Stolons arching

ROOTS

5 **Taproot present**

6 **Rhizome** (a creeping, underground stem with roots often produced from the nodes) **slender or stout, elongated** (>10 cm)

7 **Rhizome stout and short** (2-10 cm), **or poor** (1-2 cm)

8 **Root stock** a **corm** (an enlarged solid fleshy base of a stem with scales), **caudex** (short thick vertical or branched perennial stem, usually underground), **crown** (that part of the stem situated at the surface of the ground), **or tuber** (thick storage stem with an enlarged fleshy base, usually not upright)

9 **Tuberous roots, roots creeping, or woody base**

10 **Fibrous roots present**

PLANT FRAGRANCE

11 **Aromatic** (having a sweet, spicy, pungent, or fragrant odor)

ARMAMENT OR OTHER PLANT BODY FEATURES

16 **Axillary spines** (a sharp-pointed, stiff woody body arising from below epidermis), **thorns** (a sharp-pointed, stiff woody body derived from a modified branch), **or leafy fascicles** (condensed or close clusters) **present**

LATEX

17 **Latex** (milky-white, yellowish, or reddish thickened colloidal sap) **present**

VESTITURE OR STEM SURFACE

18 **Stem, leaves, or phyllaries** (involucral bracts) **glandular-hairy**

19 **Stem, leaves, or phyllaries velvety** (covered with a fine and dense silky pubescence) **or woolly** (having long, soft, entangled hairs)

20 **Stem or leaf surface rough** (**hispid** [covered with long, rigid, bristly hairs] **or scabrid** [harsh or rough to the touch because of bristly hairs])

21 **Stem, leaves, or phyllaries** (involucral bracts) **gummy**

22 **Stem, leaf, or phyllary glands resinous** (having a lustrous, yellowish, sticky exudate) **or nonresinous**

23 **Stem, leaves, or phyllaries canescent** (covered with a dense, fine, grayish-white or hoary pubescence)

33 **Stem surfaces glaucous** (covered with a whitened bloom or smooth waxy coating), **red, purple, or angled.**

34 **Stem surfaces glabrous** (without hairs)

35 **Stem surfaces pubescent** (soft, short, down-like hairs) **throughout**

36 **Stem surfaces pubescent in inflorescence** (the flowering part of the plant) **or below heads**

STEM NUMBER
24 **1**
25 **2 or more**

STEM CONDITION
26 **Sprawling, scrambling, prostrate** (trailing or lying flat), **or decumbent** (reclining with tips ascending)
27 **Rooting at lower nodes**
28 **Hollow or with a central cavity**

STEM HEIGHT
29 **<50 cm** (<20 in)
30 **50-100 cm** (20-40 in)
31 **100-150 cm** (40-60 in)
32 **>150 cm** (>60 in, >5 ft)

*LEAF POSITION
40 **Opposite below, alternate above**
41 **Chiefly basal**
42 **Chiefly opposite** (two leaves at a node)
43 **Chiefly alternate** (one leaf at a node)
44 **Whorled** (three or more leaves at a node)

LEAF TYPE
45 **Twice or thrice pinnately dissected or compound**
46 **Once pinnately lobed, dissected or compound**
47 **Palmately toothed, lobed, or compound**
48 **Submerged leaves dissected**
49 **Conduplicate** (hinged together lengthwise)
50 **Basal or lower leaves deciduous**
51 **Nearly fleshy**
52 **Reduced on branches (bracteal)**

CAULINE (stem) LEAVES
37 **Unreduced upward**
38 **Abruptly reduced upward**
39 **Few or bracteal** (modified and subtending a flower)

CAULINE LEAF PAIR NUMBER
53 **1-10**
54 **11-20**

LEAF BLADE SHAPE
55 **Linear** (narrow and flat, with sides parallel) **or filiform** (thread like; long, slender, and terete)
56 **Oblong** (two to four times longer than wide with sides parallel)
57 **Elliptic** (widest in center with two parallel ends equal) **or round**
58 **Ovate** (egg-shaped, widest below the middle) **or triangular**
59 **Obovate** (inversely ovate, with broadest half above middle and narrower toward base), **oblanceolate** (inversely lanceolate, with broader half above middle and tapering toward base), **or spatulate** (spatula-like, rounded above and gradually narrowed to base)
60 **Rhomboid** (about as long as wide, broadest at middle and tapering to base and apex), **reniform** (kidney-shaped), **or round**

LEAF APEX
61 **Obtuse** (margins forming a terminal angle >90 degrees), **blunt, or round**
62 **Acute** (margins form a terminal angle of 45-90 degrees)
63 **Acuminate** (margins form a terminal angle of <45 degrees)

LEAF MARGIN
64 **Entire** (without teeth)
65 **Crenate** (scalloped with rounded teeth), **serrate** (sharp rather coarse saw-like teeth that point forward) **or toothed**

66 **Revolute** (margins rolled under toward lower side of leaf) **or undulate** (margin wavy perpendicular to plane of blade)

LEAF BASE
67 **Amplexicaul** (clasping the stem), **clasping, or auriculate** (ear-shaped)
68 **Cordate** (heart-shaped with notch at base and ovate in general outline), **truncate** (cut squarely across), **or sagittate** (arrowhead-shaped with the basal lobes turned downward)
69 **Sessile** (without a stalk) or with a stalk <1 mm
70 **Connate** (united) **or perfoliate** (having the stem apparently passing through the leaf or the apparent fusion of leaf bases)
71 **Decurrent** (extending downward from the point of insertion of stem)

LEAF VENATION
72 **Palmately (parallel) veined**
73 **With 2 or more lateral veins (palmi-pinnate)** (basal veins without veinals attached)
74 **Obscure above and/or below (midrib evident)**
75 **With conspicuous reticulum** (a network of fibers) **beneath**

LEAF BLADE VESTITURE
76 **Glaucous** (covered with a whitened bloom or smooth waxy coating) or **glutinous** (having a shiny, sticky surface)
77 **Glabrous** (without hairs)
78 **Pubescent** (covered with soft, short, down-like hairs) **on both surfaces**
79 **Pubescent below**
80 **Pubescent above**
81 **With appressed** (pressed flat against leaf blade) **tomentum** (covered with dense, interwoven wooly hair) **above or beneath**
82 **Glandular punctate** (covered with translucent internal glands or colored dots)
83 **Spiny** (a sharp woody or rigid outgrowth from stem) **or prickly** (a small slender sharp outgrowth from epidermis) **above**
84 **Spiny or prickly beneath**
85 **Margins, teeth, or tip spiny or prickly**
86 **Teeth or margins bristly** (a stiff hair)

*LEAF BLADE LENGTH
87 **<5 cm (<2 in)**
88 **5-10 cm (2-4 in)**
89 **10-20 cm (4-8 in)**
90 **20-70 cm (8-28 in)**

*LEAF BLADE WIDTH
91 **<5 mm**
92 **5-10 mm (3/16-3/8 in)**
93 **10-20 mm (3/8-3/4 in)**
94 **20-30 mm (3/4-1 1/8 in)**
95 **30-50 mm (1 1/8-2 in)**
96 **50-100 mm (2-4 in)**
97 **>100 mm (>4 in)**

PETIOLES
98 **Length <1 cm**
99 **Length 1-10 cm (3/8-4 in)**
100 **Length 10-20 cm (4-8 in)**
101 **Length >20 cm (>8 in)**
102 **Bristly, winged, connate** (united) **or auriculate** (ear-like)

*INFLORESCENCE POSITION
103 **Axillary**
104 **Terminal**

*INFLORESCENCE TYPE

105 **Cymose** (a determinate inflorescence, of various shapes or degrees of branching, but the oldest flower is always on the end of the branch)
106 **Racemiform** (an unbranched elongate inflorescence with pedicelled flowers)
107 **Spiciform** (an unbranched, elongate inflorescence with sessile flowers)
108 **Corymbiform** (a flat-topped or convex raceme with lower pedicels elongated and rachis shortened)
109 **Of glomerules** (densely packed cluster of flowers)
110 **Paniculiform** (a branched elongate inflorescence with two or more pedicelled flowers per branch)
111 **Thyrsoid** (a cylindrical or ovoid-pyramidal, usually densely flowered panicle)
112 **Compound corymb\cyme**

INFLORESCENCE NATURE

113 **Diffuse or open**
114 **Dioecious** (unisexual, with the two kinds of flowers on separate plants)
115 **Monoecious** (with stamens and pistils in separate flowers on same plant)
116 **Recurved** (curved downward or backward) **and/or secund** (comb-like or directed to one side only)
117 **Compact**
118 **Somewhat loose**
119 **Leafy**
120 **Heads** (dense sessile aggregate of flowers) **nodding** (hanging down)
121 **Heads 1 per stem/branch**

HEADS PER PLANT

122 **1**
123 **2-10**
124 **11-20**
125 **21-30**
126 **>30**

PEDUNCLE (primary flower stalk) LENGTH (IF PRESENT)

127 **<1 cm**
128 **1-5 cm**
129 **5-20 cm**
130 **>20 cm**

INVOLUCRE

131 **False (terminal leaves clustered below the heads)**
132 **Scarious** (thin and dry, appearing shriveled) **and/or woolly**

INVOLUCRE LENGTH

133 **<0.5 cm**
134 **0.5-1 cm**
135 **1-2 cm**
136 **2-3 cm**
137 **3-4 cm**
138 **4-5 cm**
139 **>5 cm** (>2 in)

PHYLLARIES (involucral bracts) PER HEAD

140 **2-10**
141 **10-20**
142 **>20**

PHYLLARY ARRANGEMENT AND NATURE

143 **In 1-several series, subequal**
144 **Imbricate** (having overlapping margins)
145 **Dimorphic in color or in 2 sets**
146 **Outer and/or inner phyllaries united**
147 **Phyllary body or its tip spreading or reflexed** (abruptly bent or turned downward) **at maturity**
148 **Foliaceous** (leaf-like texture or appearance), **tubercled** (a small node or gland-like structure), **pectinate** (divided like the teeth of a comb), **or spiny** (a sharp woody or rigid outgrowth from stem)
149 **Ciliate** (with conspicuous marginal hairs)
150 **Hairy**
151 **Hyaline** (transparent or translucent) **or scarious** (thin, dry, and membranous) **margined**
152 **Nerved or ribbed**
153 **Dorsal keel** (if present) **of phyllary midregion winged**
154 **Dorsal keel** (if present) **of phyllary midregion not winged**

PHYLLARY APEX

155 **Obtuse** (margins forming a terminal angle >90 degrees) **or blunt**
156 **Acute** (margins forming a terminal angle of 45-90 degrees)
157 **Acuminate** (margins form a terminal angle of <45 degrees) **or caudate** (having a slender tail-like appendage)
158 **Folded or mucronate** (with a short, small abrupt tip)
159 **Cuspidate** (tipped with a sharp, firm point) **or spine-tipped**
160 **Green**
161 **Non-green**

*RAY COROLLA COLOR

162 **Yellow/orange, bisexual (no disk)**
163 **Nonyellow/nonorange (no disk)**
164 **Yellow/orange with yellow disk**
165 **Yellow/orange with non-yellow disk**
166 **Non-yellow/non-orange with yellow disk**
167 **Non-yellow/non-orange with non-yellow disk**

RAY FLOWER NATURE

168 **Pistillate**
169 **Sterile**

*RAY/PISTILLATE (DISCIFORM) FLOWERS PER HEAD

170 **1-5**
171 **5-10**
172 **10-20**
173 **20-50**
174 **50-100**
175 **100-150**
176 **>150**

RAY COROLLA NATURE

177 **Tip 2-toothed**
178 **Tip 3+ toothed**
179 **Reflexed** (abruptly bent or turned downward)
180 **Base and tip differently colored**

RAY COROLLA LENGTH

181 **<5 mm**
182 **5-15 mm** (3/16-5/8 in)
183 **15-30 mm** (5/8-1 1/8 in)
184 **>30 mm** (>1 1/8 in)

*DISK COLOR

185 **Yellow (no rays)**
186 **Non-yellow (no rays)**

DISK NATURE

187 **Disciform (neither liguled nor 5-lobed) pistillate flowers present**
188 **Corolla resinous** (having a yellowish, sticky exudate) **or hairy (inside or outside)**
189 **Corolla bulbous-based or 4-toothed**
190 **All or central flowers sterile**

DISK WIDTH

191 **<0.5 cm**
192 **0.5-1 cm**
193 **1-2 cm**
194 **2-3 cm**
195 **3-4 cm**
196 **4-5 cm**
197 **>5 cm** (>2 in)

DISK FLOWER NUMBER
198 **1-4**
199 **5-10**
200 **11-20**
201 **21-40**
202 **41-60**
203 **>60**

*RECEPTACLE
204 **Columnar or conic**
205 **Length >1 cm**
206 **Chaffy** (a small thin scale or bract, becoming dry and membranous) **all over**
207 **Chaffy along margin or centrally**
208 **Chaff united forming a honeycomb or cup**
209 **Chaff/phyllary clasping disk and/or ray fruits**
210 **Not chaffy**

*PAPPUS (group of bristles, hairs, awns, or scale-like structures at apex of achene)
236 **Absent in ray or in all flowers**
237 **Of capillary bristles** (stiff hairs)
238 **Bristles slender or clavate** (club-shaped)
239 **Bristles scabrid** (rough to the touch) **or barbed** (bearing sharp, rigid reflexed points, like barbs of a fish-hook)
240 **Bristles plumose** (having fine and elongate hairs, like the plume of a feather)
241 **Bristles united at base**
250 **Bristles white**
251 **Bristles yellow**
252 **Bristles red or brown**
253 **Bristles purple or pink**
242 **Of awns** (bristle-like appendages)
243 **Awns retrorsely barbed** (directed back or downward)
244 **Awns antrorsely barbed** (directed forward or upward)
245 **Of scales** (thin, scarious bodies)
246 **Of a crown** (united scales)
247 **Scales awned**
248 **Double or dimorphic**
249 **Deciduous** (not persistent)

FRUIT COLOR
211 **Red or brown**
212 **Black**
213 **Yellow**
214 **Purple, gray, or green**

FRUIT SHAPE
215 **Obovate** (inverse of ovate, with broadest half above middle and narrower toward base), **obovoid** (inversely ovoid, with broadest half above the middle), **or obpyramidal** (shaped like an inverted pyramid)
216 **Fusiform** (spindle-shaped, thickest near middle and tapering toward each end) **or pyramidal**
217 **Linear** (long and narrow with parallel sides) **or oblong** (sides parallel and length two or three times width)
218 **Columnar or cylindrical**
219 **3-5 angled**
220 **6-20 angled**
221 **Compressed, not winged**
222 **Compressed and winged**
223 **Thick or turbinate** (top-shaped or conical with the broad end uppermost)

FRUIT NERVE/RIB NUMBER (if present)
224 **1-5-nerved or -ribbed**
225 **6-20-nerved or -ribbed**

FRUIT BEAK
226 **Shorter than body**
227 **Equalling or longer than body**

FRUIT VESTITURE
228 **Glabrous** (without hairs)
229 **Eglandular-hairy**
230 **Rugose** (wrinkled)
231 **With stalked glands** (glandular-hairy)
232 **Bearing resinous or nonresinous sessile glands**
233 **Bearing callus dots, tubercles** (warty nodules), **or papillae** (minute, nipple-shaped projections)
234 **Prickled** (small, slender sharp outgrowth from epidermis), **muricate** (covered with short, hard protuberances), **spiny** (a sharp woody or rigid outgrowth from the stem), **or rough**
235 **Enclosed in involucre**

Aster Key, 522 taxa.

1 Achillea millefolium
2 Achyrachaena mollis
3 Acmella oppositifolia
4 Ageratina altissima
5 Ageratum conyzoides
6 Ageratum houstonianum
7 Agoseris aurantiaca
8 Agoseris elata
9 Agoseris glauca
10 Agoseris lackschewitzii
11 Amblyopappus pusillus
12 Ambrosia artemisiifolia
13 Ambrosia grayi
14 Ambrosia psilostachya
15 Ambrosia trifida
16 Antennaria arcuata
17 Antennaria corymbosa
18 Antennaria pulcherrima
19 Antennaria umbrinella
20 Anthemis cotula
21 Arnica acaulis
22 Arnica amplexicaulis
23 Arnica chamissonis
24 Arnica latifolia
25 Arnica longifolia
26 Arnica mollis
27 Arnoglossum diversifolium
28 Arnoglossum ovatum
29 Arnoglossum plantagineum
30 Arnoglossum sulcatum
31 Artemisia annua
32 Artemisia arbuscula
33 Artemisia biennis
34 Artemisia cana
35 Artemisia douglasiana
36 Artemisia lindleyana
37 Artemisia ludoviciana
38 Artemisia papposa
39 Artemisia stelleriana
40 Aster alpigenus
41 Aster borealis
42 Aster carolinianus
43 Aster chapmanii
44 Aster chilensis
45 Aster defoliatus
46 Aster dumosus
47 Aster eatonii
48 Aster elatus
49 Aster ericoides
50 Aster eryngiifolius

51 Aster falcatus
52 Aster foliaceus
53 Aster fragilis
54 Aster gracilis
55 Aster lanceolatus
56 Aster lateriflorus
57 Aster modestus
58 Aster nemoralis
59 Aster novae-angliae
60 Aster novi-belgii
61 Aster occidentalis
62 Aster ontarionis
63 Aster paludosus
64 Aster pauciflorus
65 Aster pilosus
66 Aster porteri
67 Aster praealtus
68 Aster prenanthoides
69 Aster puniceus
70 Aster radula
71 Aster reticulatus
72 Aster sibiricus
73 Aster spinulosus
74 Aster subspicatus
75 Aster subulatus
76 Aster tenuifolius
77 Aster umbellatus
78 Aster walteri
79 Aster yukonensis
80 Baccharis angustifolia
81 Baccharis dioica
82 Baccharis douglasii
83 Baccharis emoryi
84 Baccharis glomeruliflora
85 Baccharis halimifolia
86 Baccharis neglecta
87 Baccharis salicifolia
88 Baccharis salicina
89 Baccharis sarothroides
90 Baccharis sergiloides
91 Baccharis wrightii
92 Balduina atropurpurea
93 Balduina uniflora
94 Bidens amplissima
95 Bidens aristosa
96 Bidens aurea
97 Bidens bidentoides
98 Bidens bigelovii
99 Bidens cernua
100 Bidens connata
101 Bidens coronata
102 Bidens discoidea

103 Bidens eatonii
104 Bidens frondosa
105 Bidens heterodoxa
106 Bidens hyperborea
107 Bidens laevis
108 Bidens leptocephala
109 Bidens mitis
110 Bidens pilosa
111 Bidens tenuisecta
112 Bidens tripartita
113 Bigelowia nudata
114 Bigelowia nuttallii
115 Blennosperma bakeri
116 Blennosperma nanum
117 Boltonia asteroides
118 Boltonia caroliniana
119 Boltonia diffusa
120 Borrichia arborescens
121 Borrichia frutescens
122 Brachyactis ciliata
123 Brachyactis frondosa
124 Brickellia californica
125 Brickellia greenei
126 Brintonia discoidea
127 Calyptocarpus vialis
128 Carphephorus carnosus
129 Carphephorus corymbosus
130 Carphephorus odoratissimus
131 Carphephorus paniculatus
132 Carphephorus pseudoliatris
133 Carphephorus tomentosus
134 Chaptalia tomentosa
135 Chloracantha spinosa
136 Chrysoma pauciflosculosa
137 Chrysopsis mariana
138 Cirsium andrewsii
139 Cirsium arizonicum
140 Cirsium arvense
141 Cirsium crassicaule
142 Cirsium douglasii
143 Cirsium edule
144 Cirsium flodmanii
145 Cirsium foliosum
146 Cirsium fontinale
147 Cirsium horridulum
148 Cirsium hydrophilum
149 Cirsium lecontei
150 Cirsium mohavense
151 Cirsium muticum
152 Cirsium nuttallii
153 Cirsium pallidum
154 Cirsium parryi

155 Cirsium scariosum
156 Cirsium undulatum
157 Cirsium vinaceum
158 Cirsium virginianum
159 Cirsium vulgare
160 Clappia suaedifolia
161 Conyza canadensis
162 Coreopsis falcata
163 Coreopsis floridana
164 Coreopsis gladiata
165 Coreopsis integrifolia
166 Coreopsis lanceolata
167 Coreopsis leavenworthii
168 Coreopsis linifolia
169 Coreopsis nudata
170 Coreopsis pubescens
171 Coreopsis rosea
172 Coreopsis tinctoria
173 Coreopsis tripteris
174 Cosmos bipinnatus
175 Cosmos parviflorus
176 Cotula coronopifolia
177 Crepis runcinata
178 Croptilon divaricatum
179 Dendranthema arcticum
180 Dracopis amplexicaulis
181 Dugaldia hoopesii
182 Eclipta prostrata
183 Egletes viscosa
184 Elephantopus carolinianus
185 Elephantopus nudatus
186 Enceliopsis nudicaulis
187 Erechtites hieraciifolia
188 Erigeron annuus
189 Erigeron coulteri
190 Erigeron elatior
191 Erigeron flagellaris
192 Erigeron formosissimus
193 Erigeron glaucus
194 Erigeron howellii
195 Erigeron humilis
196 Erigeron hyssopifolius
197 Erigeron melanocephalus
198 Erigeron peregrinus
199 Erigeron philadelphicus
200 Erigeron procumbens
201 Erigeron pulchellus
202 Erigeron quercifolius
203 Erigeron strigosus
204 Erigeron vernus
205 Eupatorium anomalum
206 Eupatorium capillifolium

207 Eupatorium compositifolium
208 Eupatorium dubium
209 Eupatorium fistulosum
210 Eupatorium incarnatum
211 Eupatorium leptophyllum
212 Eupatorium leucolepis
213 Eupatorium maculatum
214 Eupatorium mikanioides
215 Eupatorium mohrii
216 Eupatorium perfoliatum
217 Eupatorium pilosum
218 Eupatorium purpureum
219 Eupatorium pycnocephalum
220 Eupatorium resinosum
221 Eupatorium rotundifolium
222 Eupatorium semiserratum
223 Eupatorium serotinum
224 Euthamia graminifolia
225 Euthamia gymnospermoides
226 Euthamia leptocephala
227 Euthamia occidentalis
228 Euthamia tenuifolia
229 Evax caulescens
230 Evax sparsiflora
231 Flaveria brownii
232 Flaveria campestris
233 Flaveria chlorifolia
234 Flaveria floridana
235 Flaveria linearis
236 Gamochaeta pennsylvanica
237 Gamochaeta purpurea
238 Gnaphalium canescens
239 Gnaphalium grayi
240 Gnaphalium luteoalbum
241 Gnaphalium palustre
242 Gnaphalium stramineum
243 Gnaphalium uliginosum
244 Grindelia camporum
245 Grindelia fraxinopratensis
246 Grindelia humilis
247 Grindelia integrifolia
248 Grindelia latifolia
249 Grindelia nana
250 Grindelia paludosa
251 Grindelia procera
252 Grindelia robusta
253 Grindelia squarrosa
254 Hartwrightia floridana
255 Helenium amarum
256 Helenium arizonicum
257 Helenium autumnale
258 Helenium bigelovii

259	Helenium bolanderi
260	Helenium brevifolium
261	Helenium campestre
262	Helenium drummondii
263	Helenium flexuosum
264	Helenium microcephalum
265	Helenium pinnatifidum
266	Helenium puberulum
267	Helenium thurberi
268	Helenium vernale
269	Helianthella quinquenervis
270	Helianthus agrestis
271	Helianthus angustifolius
272	Helianthus annuus
273	Helianthus bolanderi
274	Helianthus californicus
275	Helianthus carnosus
276	Helianthus ciliaris
277	Helianthus debilis
278	Helianthus decapetalus
279	Helianthus floridanus
280	Helianthus giganteus
281	Helianthus grosseserratus
282	Helianthus heterophyllus
283	Helianthus longifolius
284	Helianthus maximiliani
285	Helianthus microcephalus
286	Helianthus nuttallii
287	Helianthus occidentalis
288	Helianthus radula
289	Helianthus simulans
290	Helianthus tuberosus
291	Hemizonia paniculata
292	Hemizonia parryi
293	Hemizonia pungens
294	Heterotheca subaxillaris
295	Hieracium greenii
296	Hieracium gronovii
297	Holozonia filipes
298	Hymenoxys texana
299	Hypochaeris radicata
300	Isocoma acradenia
301	Isocoma menziesii
302	Iva acerosa
303	Iva annua
304	Iva axillaris
305	Iva frutescens
306	Iva hayesiana
307	Iva imbricata
308	Iva microcephala
309	Iva xanthifolia
310	Jamesianthus alabamensis

311 Jaumea carnosa
312 Krigia biflora
313 Krigia cespitosa
314 Krigia dandelion
315 Krigia virginica
316 Lactuca biennis
317 Lactuca canadensis
318 Lactuca floridana
319 Lactuca graminifolia
320 Lactuca ludoviciana
321 Lactuca saligna
322 Lactuca serriola
323 Lactuca tatarica
324 Laennecia coulteri
325 Lasthenia burkei
326 Lasthenia californica
327 Lasthenia chrysantha
328 Lasthenia conjugens
329 Lasthenia fremontii
330 Lasthenia glaberrima
331 Lasthenia glabrata
332 Lasthenia minor
333 Lasthenia platycarpha
334 Layia chrysanthemoides
335 Layia heterotricha
336 Layia munzii
337 Leontodon taraxacoides
338 Liatris acidota
339 Liatris garberi
340 Liatris gracilis
341 Liatris lancifolia
342 Liatris ligulistylis
343 Liatris pycnostachya
344 Liatris scariosa
345 Liatris spicata
346 Machaeranthera bigelovii
347 Machaeranthera boltoniae
348 Machaeranthera canescens
349 Machaeranthera carnosa
350 Machaeranthera coulteri
351 Machaeranthera phyllocephala
352 Madia glomerata
353 Marshallia caespitosa
354 Marshallia graminifolia
355 Marshallia grandiflora
356 Marshallia mohrii
357 Marshallia ramosa
358 Marshallia trinervia
359 Matricaria discoidea
360 Matricaria maritima
361 Matricaria perforata
362 Megalodonta beckii

363 Melampodium perfoliatum
364 Melanthera angustifolia
365 Melanthera nivea
366 Microseris borealis
367 Mikania cordifolia
368 Mikania scandens
369 Petasites frigidus
370 Petasites sagittatus
371 Phalacroseris bolanderi
372 Picris echioides
373 Pityopsis graminifolia
374 Pityopsis oligantha
375 Pluchea camphorata
376 Pluchea carolinensis
377 Pluchea foetida
378 Pluchea longifolia
379 Pluchea odorata
380 Pluchea rosea
381 Pluchea sagittalis
382 Pluchea sericea
383 Prenanthes alba
384 Prenanthes altissima
385 Prenanthes aspera
386 Prenanthes autumnalis
387 Prenanthes crepidinea
388 Prenanthes racemosa
389 Prionopsis ciliata
390 Psilocarphus brevissimus
391 Psilocarphus elatior
392 Psilocarphus oregonus
393 Psilocarphus tenellus
394 Pterocaulon virgatum
395 Pyrrocoma hirta
396 Pyrrocoma lanceolata
397 Pyrrocoma racemosa
398 Pyrrocoma uniflora
399 Raillardella pringlei
400 Rudbeckia auriculata
401 Rudbeckia californica
402 Rudbeckia fulgida
403 Rudbeckia graminifolia
404 Rudbeckia hirta
405 Rudbeckia laciniata
406 Rudbeckia maxima
407 Rudbeckia missouriensis
408 Rudbeckia mohrii
409 Rudbeckia nitida
410 Rudbeckia occidentalis
411 Rudbeckia scabrifolia
412 Rudbeckia subtomentosa
413 Rudbeckia triloba
414 Saussurea angustifolia

415 Saussurea nuda
416 Sclerolepis uniflora
417 Senecio amplectens
418 Senecio anonymus
419 Senecio atropurpureus
420 Senecio aureus
421 Senecio clarkianus
422 Senecio clevelandii
423 Senecio congestus
424 Senecio crassulus
425 Senecio crocatus
426 Senecio cymbalaria
427 Senecio cymbalarioides
428 Senecio debilis
429 Senecio eremophilus
430 Senecio glabellus
431 Senecio hydrophiloides
432 Senecio hydrophilus
433 Senecio indecorus
434 Senecio integerrimus
435 Senecio lugens
436 Senecio macounii
437 Senecio obovatus
438 Senecio pauciflorus
439 Senecio pauperculus
440 Senecio plattensis
441 Senecio pseudaureus
442 Senecio pseudoarnica
443 Senecio quaerens
444 Senecio salignus
445 Senecio schweinitzianus
446 Senecio serra
447 Senecio sphaerocephalus
448 Senecio streptanthifolius
449 Senecio tampicanus
450 Senecio tomentosus
451 Senecio triangularis
452 Senecio vulgaris
453 Senecio werneriifolius
454 Silphium perfoliatum
455 Silphium terebinthinaceum
456 Solidago arguta
457 Solidago caesia
458 Solidago canadensis
459 Solidago confinis
460 Solidago fistulosa
461 Solidago flexicaulis
462 Solidago gigantea
463 Solidago glomerata
464 Solidago gracillima
465 Solidago houghtonii
466 Solidago latissimifolia

467 Solidago leavenworthii
468 Solidago multiradiata
469 Solidago ohioensis
470 Solidago patula
471 Solidago puberula
472 Solidago riddellii
473 Solidago rigida
474 Solidago rugosa
475 Solidago sempervirens
476 Solidago spathulata
477 Solidago spectabilis
478 Solidago stricta
479 Solidago uliginosa
480 Solidago verna
481 Soliva sessilis
482 Sonchus arvensis
483 Sonchus asper
484 Sonchus oleraceus
485 Sphaeromeria potentilloides
486 Stokesia laevis
487 Synedrella nodiflora
488 Synosma suaveolens
489 Taraxacum officinale
490 Tithonia diversifolia
491 Tithonia thurberi
492 Trichocoronis rivularis
493 Trichocoronis wrightii
494 Trimorpha acris
495 Trimorpha lonchophylla
496 Tussilago farfara
497 Verbesina alternifolia
498 Verbesina chapmanii
499 Verbesina encelioides
500 Verbesina heterophylla
501 Verbesina occidentalis
502 Verbesina virginica
503 Verbesina walteri
504 Vernonia angustifolia
505 Vernonia arkansana
506 Vernonia baldwinii
507 Vernonia blodgettii
508 Vernonia fasciculata
509 Vernonia gigantea
510 Vernonia lettermannii
511 Vernonia marginata
512 Vernonia missurica
513 Vernonia noveboracensis
514 Vernonia texana
515 Wedelia trilobata
516 Wyethia amplexicaulis
517 Wyethia angustifolia
518 Wyethia helianthoides

519 Xanthium spinosum
520 Xanthium strumarium
521 Xanthocephalum gymnospermoides
522 Youngia japonica

467 Solidago leavenworthii
468 Solidago multiradiata
469 Solidago ohioensis
470 Solidago patula
471 Solidago puberula
472 Solidago riddellii
473 Solidago rigida
474 Solidago rugosa
475 Solidago sempervirens
476 Solidago spathulata
477 Solidago spectabilis
478 Solidago stricta
479 Solidago uliginosa
480 Solidago verna
481 Soliva sessilis
482 Sonchus arvensis
483 Sonchus asper
484 Sonchus oleraceus
485 Sphaeromeria potentilloides
486 Stokesia laevis
487 Synedrella nodiflora
488 Synosma suaveolens
489 Taraxacum officinale
490 Tithonia diversifolia
491 Tithonia thurberi
492 Trichocoronis rivularis
493 Trichocoronis wrightii
494 Trimorpha acris
495 Trimorpha lonchophylla
496 Tussilago farfara
497 Verbesina alternifolia
498 Verbesina chapmanii
499 Verbesina encelioides
500 Verbesina heterophylla
501 Verbesina occidentalis
502 Verbesina virginica
503 Verbesina walteri
504 Vernonia angustifolia
505 Vernonia arkansana
506 Vernonia baldwinii
507 Vernonia blodgettii
508 Vernonia fasciculata
509 Vernonia gigantea
510 Vernonia lettermannii
511 Vernonia marginata
512 Vernonia missurica
513 Vernonia noveboracensis
514 Vernonia texana
515 Wedelia trilobata
516 Wyethia amplexicaulis
517 Wyethia angustifolia
518 Wyethia helianthoides

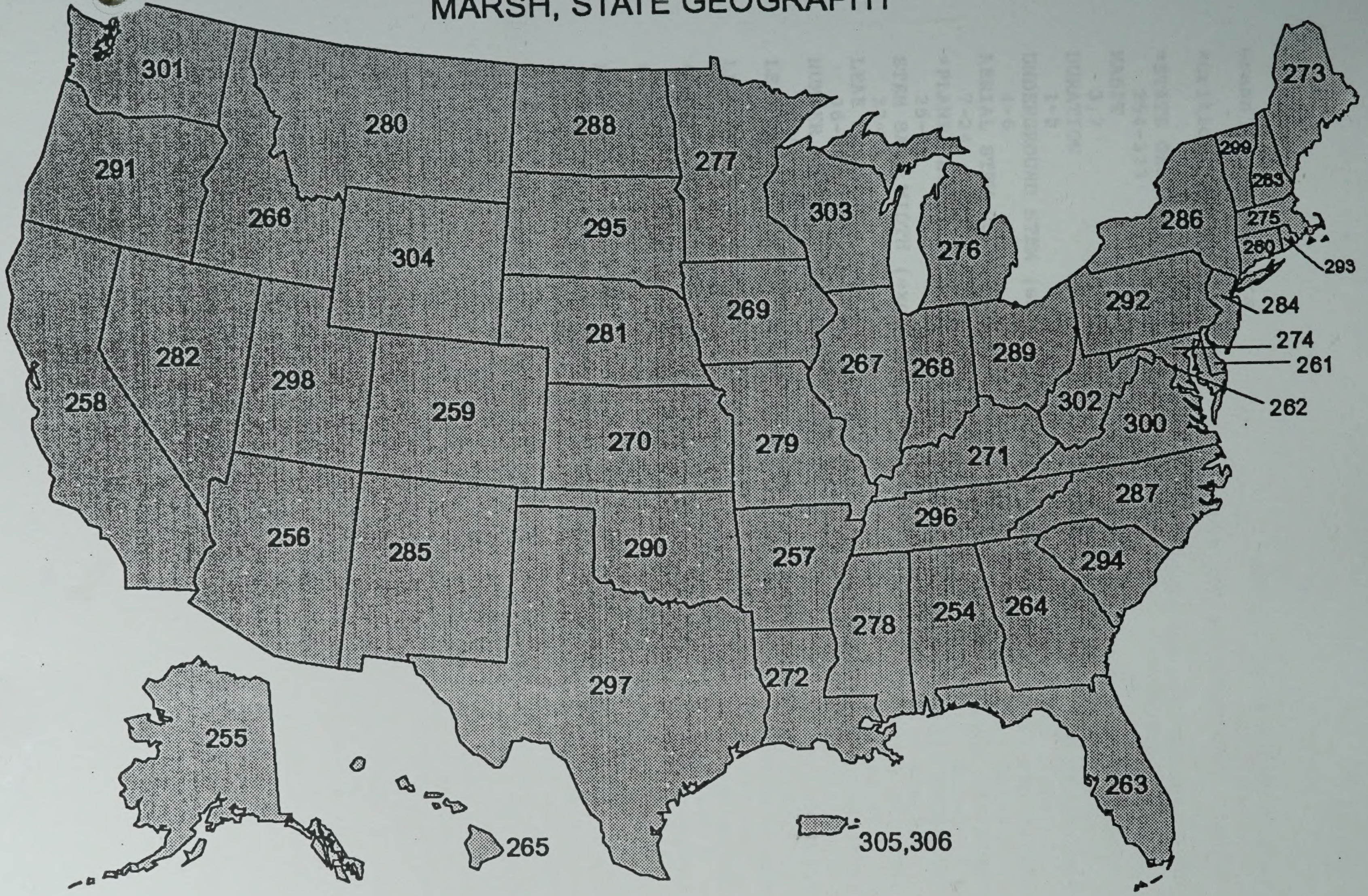
GRASS

General	Culm	Leaf	Floral/ Inflorescence	Spikelet	Fruit
Geography 294–323	Vestiture 19–20	Size 52–64	Position 80–82	Apex 126–127	Vestiture 245–246
Size 25–31	Shape 23–24	Position 36–38	Size 83–90	Number 134–142	Color 247–250
Duration/ Habit 1–3 7 13–16	Pith 21–22	Number 39–42	Type 79 95–101	Size 143–152	Size 251–253
Root/ Rhizome 4–6	Branching 8–12	Margin 43–44	Rachis 102–112	Position 128–133 158–160	
	Base 9–11 17–18 32–35	Vestiture 49–50	Primary Branch 113–125	Gender 90 161–165	
		Shape 46–48	Peduncle 91–94	Glume 166–186	
		Base 45 51	Vestiture 78	Lemma 187–224	
		Venation 65–67		Color 153–157	
		Sheath 68–72		Stamen 225–234	
		Ligule 73–77		Stigma 235–244	

GRASS

General	Stem	Leaf	Flower/ Inflorescence	Spikelet	Fruit
Geography 254–323	Vestiture 19–20	Size 52–64	Position 81–82	Apex 126–127	Vestiture 245–246
Size 25–31	Shape 23–24	Position 36–38	Size 83–90	Number 134–142	Color 247–250
Duration/ Habit 1–3 7 13–16	Pith 21–22	Number 39–42	Type 79 95–101	Size 143–152	Size 251–253
Root/ Rhizome 4–6	Branching 8–12	Margin 43–44	Rachis 102–112	Position 128–133 158–160	
	Base 9–11 17–28 32–35	Vestiture 49–50	Primary Branch 113–125	Gender 80 161–165	
		Shape 46–48	Peduncle 91–94	Glume 166–186	
		Base 45 51	Vestiture 78	Lemma 187–224	
		Venation 65–67		Color 153–157	
		Sheath 68–72		Stamen 225–234	
		Ligule 73–77		Stigma 239–244	

MARSH, STATE GEOGRAPHY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Grass Key Characters

*Critical Characters

*STATE GEOGRAPHY
254-323
HABIT
3,7
DURATION
1-2
UNDERGROUND STEM (skip this for annuals)
4-6
AERIAL STEM CONDITION AND ARRANGEMENT
7-24
*PLANT HEIGHT
25-31
STEM BASE WIDTH (excluding leaf sheaths)
32-35
LEAF POSITION
36-38
NUMBER OF WELL-DEVELOPED STEM LEAVES
39-42
LEAF BLADE MARGINS IN BUD
43-44
LEAF BLADE CONDITION
45-51
*LEAF BLADE LENGTH
52-56
*LEAF BLADE WIDTH
57-64
LEAF BLADE VENATION
65-67
LEAF SHEATH CONDITION
68-72
LIGULE STRUCTURE AND LENGTH
73-77
INFLORESCENCE
78-80
*INFLORESCENCE POSITION
81-82
*INFLORESCENCE WIDTH
83-85
*INFLORESCENCE LENGTH
86-90
PEDUNCLE LENGTH (from the uppermost stem node)
91-94
*INFLORESCENCE TYPE
95-99
INFLORESCENCE SHAPE
100, 101
TERMINATING RACHIS CONDITION
102-108

NUMBER OF NODES ON RACHIS
109-112
PRIMARY BRANCH NUMBER PER BASAL NODE OF INFLORESCENCE
113-115
BASAL PRIMARY BRANCH LENGTH, CONDITION AND ARRANGEMENT OF INFLORESCENCE
116-125
*SPIKELET CONDITION
126-133
*SPIKELETS PER NODE
134-137
*SPIKELETS PER INFLORESCENCE
138-142
*SPIKELET LENGTH
143-148
*SPIKELET WIDTH
149-152
SPIKELET COLOR
153-157
*SPIKELET DISARTICULATION
158-160
*BISEXUAL OR FEMALE FLOWERS PER SPIKELET
161-165
*GLUME NUMBER AND CONDITION
166-174
SECOND GLUME CONDITION
175-179
SECOND GLUME APEX
180-186
*FERTILE LEMMA CONDITION
187-202
*FERTILE LEMMA AWN NUMBER, ARRANGEMENT AND LENGTH
203-214
*FERTILE LEMMA NERVE NUMBER
215-218
*FERTILE LEMMA LENGTH
219-224
*STAMENS PER FLOWER
225-228
*ANTHER LENGTH
229-234
ANTHER COLOR
235-238
*STIGMA NUMBER
239-240
STIGMA COLOR
241-244
FRUIT VESTITURE
245-246
FRUIT COLOR
247-250

FRUIT LENGTH
251-253

Grass Key, 323 Characters

*Critical Characters

*STATE GEOGRAPHY
254 **Alabama**
255 **Alaska**
256 **Arizona**
257 **Arkansas**
258 **California**
259 **Colorado**
260 **Connecticut**
261 **Delaware**
262 **District of Columbia**
263 **Florida**
264 **Georgia**
265 **Hawaii**
266 **Idaho**
267 **Illinois**
268 **Indiana**
269 **Iowa**
270 **Kansas**
271 **Kentucky**
272 **Louisiana**
273 **Maine**
274 **Maryland**
275 **Massachusetts**
276 **Michigan**
277 **Minnesota**
278 **Mississippi**
279 **Missouri**
280 **Montana**
281 **Nebraska**
282 **Nevada**
283 **New Hampshire**
284 **New Jersey**
285 **New Mexico**
286 **New York**
287 **North Carolina**
288 **North Dakota**
289 **Ohio**
290 **Oklahoma**
291 **Oregon**
292 **Pennsylvania**
293 **Rhode Island**
294 **South Carolina**
295 **South Dakota**
296 **Tennessee**
297 **Texas**
298 **Utah**
299 **Vermont**
300 **Virginia**

301 Washington
302 West Virginia
303 Wisconsin
304 Wyoming
305 Puerto Rico
306 Virgin Islands
307 Alberta
308 British Columbia
309 Franklin
310 Keewatin
311 Labrador
312 MacKenzie
313 Manitoba
314 New Brunswick
315 Newfoundland
316 Nova Scotia
317 Ontario
318 Prince Edward Island
319 Quebec
320 Saskatchewan
321 Yukon Territory
322 Greenland (Denmark)
323 St. Pierre and Miquelon Islands (France

HABIT
3 **Mat-forming or colonial (in clumps)**
7 **Woody or nearly so**

DURATION
1 **Annual/Biennial** (living for one or two years)
2 **Perennial** (living several to many seasons)

UNDERGROUND STEM (skip this for annuals)
4 **Long Rhizome** (a creeping, underground stem with roots often produced from nodes) **>10 cm or stolon** (a shoot that bends to the ground and takes root or a horizontal stem at or below the surface of the ground that gives rise to a new plant at top (the tip) **present**
5 **Short Rhizome** (< 10 cm) **present or rhizome absent**
6 **Corm** (an enlarged solid fleshy base of a stem with scales), **tuber** (a thick storage stem with an enlarged fleshy base, usually upright) **or bulb** (an underground leaf bud with thickened scales) **present**

AERIAL STEM CONDITION AND ARRANGEMENT
7 **Woody or nearly so**
8 **Solitary**
9 **Caespitose (2+)**
10 **Branched above the base**
11 **Branched at the base**
12 **Unbranched**
13 **Floating or submerged**
14 **Decumbent** (reclining with tips ascending) **and/or rooting at lower nodes**
15 **Erect** (stem upright)
16 **Ascending** (rising obliquely or curving upward), **spreading, or nodding** (hanging down)
17 **Base with remains of old leaf sheaths**
18 **Base without remains of old leaf sheaths**
19 **Glabrous** (without hairs)
20 **Rough or hairy (at nodes or throughout)**
21 **Internodes solid, semi-solid or spongy**
22 **Internodes hollow**
23 **Internodes flattened or compressed**
24 **Internodes round**

*PLANT HEIGHT (includes inflorescence)
25 **1-10 cm**
26 **10-20 cm** (4-8 in.)
27 **20-50 cm** (8-20 in.)
28 **50-100 cm** (20-40 in.)
29 **100-150 cm** (40-60 in.)
30 **150-200 cm** (60-80 in.) (5-6 1/2 ft.)
31 **>200 cm** (80 in.) (>6 1/2 ft.)

STEM BASE WIDTH (excluding leaf sheaths, at 1 cm above ground level)
32 **0.1-2 mm**
33 **2-5 mm**
34 **5-10 mm**
35 **>10 mm**

LEAF POSITION
36 **Leaves cauline** (on stem)
37 **Leaves basal or nearly so**
38 **Winter rosette** (a crowded cluster of radiating leaves appearing to rise from the ground) **present**

NUMBER OF WELL-DEVELOPED STEM LEAVES
39 **0-5**
40 **5-10**
41 **10-20**
42 **>20**

LEAF BLADE MARGINS IN BUD
43 **Folded or clasping**
44 **Rolled** (**convolute**)

LEAF BLADE CONDITION
45 **Pseudopetiolate, sheathing, cordate, sessile or nearly so**
46 **Flat or nearly so**
47 **Folded**
48 **Revolute** (margin rolled toward under lower side of leaf) or **involute** (margin rolled inward toward upper side of leaf) **along the margins**
49 **Essentially glabrous** (without hairs)
50 **Hairy or rough** (**above and/or below**)
51 **Base auricled** (ear-shaped)

*LEAF BLADE LENGTH (tip to collar)
52 **1-5 cm**
53 **5-10 cm** (2-4 in.)
54 **10-20 cm** (4-8 in.)
55 **20-50 cm** (8-20 in.)
56 **>50 cm** (>20 in.)

*LEAF BLADE WIDTH
57 **0.1-0.5 mm**
58 **0.5-2 mm**
59 **2-5 mm**
60 **5-10 mm**
61 **10-15 mm**
62 **15-20 mm**
63 **20-30 mm**
64 **>30 mm**

LEAF BLADE VENATION
65 **Midnerves as thick as lateral nerves**
66 **Midnerves** (**above or below**) **thicker than lateral nerves**
67 **Upper surface bearing 2 conspicuous median nerves**

LEAF SHEATH CONDITION
68 **Margins united at least 1/4 of their length**
69 **Open to the base or nearly so**
70 **Body or margins hairy or rough**
71 **Base or tip** (**collar**) **hairy or bristly** (a stiff hair)
72 **Essentially glabrous** (without hairs)

LIGULE STRUCTURE AND LENGTH
73 **Absent**
74 **Ciliate** (fringe of fine marginal hairs), **or hairy**
75 **Membranous** (thin, soft, translucent, and pliable)
76 **0.5-4 mm**
77 **>4 mm**

INFLORESCENCE

78 **Bearing prickly or smooth burs, or with utricles** (small bladder-like bodies)
79 **Flabellate** (fan-shaped) **or feathery**
80 **Bearing unisexual or heteromorphic** (of more than one kind of form) **spikelets** (a small or secondary spike usually subtended by two glumes and containing one or more florets)

*INFLORESCENCE POSITION

81 **Terminal**
82 **Axillary and terminal**

*INFLORESCENCE WIDTH

83 **0.2-2 cm**
84 **2-10 cm**
85 **>10 cm**

*INFLORESCENCE LENGTH

86 **1-5 cm**
87 **5-10 cm** (2-4 in.)
88 **10-20 cm** (4-8 in.)
89 **20-40 cm** (8-16 in.)
90 **>40 cm** (>16 in.)

PEDUNCLE LENGTH (from the uppermost stem node)

91 **0.5-10 cm**
92 **10-20 cm** (4-8 in.)
93 **20-30 cm** (8-12 in.)
94 **>30 cm** (>12 in.)

*INFLORESCENCE TYPE

95 **Of 1-many fascicles or heads**
96 **Racemiform** (an unbranched, elongate inflorescence with pedicelled flowers) **or spiciform** (an unbranched, elongate inflorescence with sessile flowers)
97 **Digitate** (shaped as an open hand with fingers arising from one point), **subdigitate or corymbiform** (a flat-topped or convex raceme with lower pedicels elongated and rachis shortened)
98 **Panicle diffuse or open** (a branched elongate inflorescence with two or more pedicelled flowers per branch)
99 **Panicle compact or contracted**

INFLORESCENCE SHAPE

100 **Ovoid** (broadly elliptical, a flattened circle usually more than twice as long as broad) **or pyramidal**
101 **Cylindrical, often dense**

TERMINATING RACHIS CONDITION
102 **In a spikelet**
103 **In a bristle** (a stiff hair)
104 **Surface with cavities from which spikelets arise**
105 **Jointed**
106 **Flattened, winged or corky**
107 **Essentially glabrous** (without hairs)
108 **Rough or Hairy**

NUMBER OF NODES ON RACHIS
109 **1**
110 **2-5**
111 **5-10**
112 **>10**

PRIMARY BRANCH NUMBER PER BASAL NODE OF INFLORESCENCE
113 **1**
114 **2**
115 **3+**

BASAL PRIMARY BRANCH LENGTH, CONDITION AND ARRANGEMENT OF INFLORESCENCE
116 **1-5 cm**
117 **5-10 cm**
118 **>10 cm**
119 **With secondary branching**
120 **Unbranched**
121 **Bearing spikelets below middle to tip**
122 **Bearing spikelets at or above middle to tip**
123 **Secund** (restricted to one side)
124 **Ascending** (rising obliquely or curving upward)
125 **Spreading or reflexed** (abruptly bent downward)

*SPIKELET CONDITION
126 **Awned** (a stiff bristle)
127 **Unawned**
128 **With discs or cupules below the glumes**
129 **Subtended by bristles** (stiff hairs)
130 **Subtended by soft hairy or smooth callus** (hardened thickening)
131 **Pedicelled** (stalked)
132 **Sessile** (not stalked) **or subsessile** (<1 mm)
133 **In 2 rows on one side of the rachis**

*SPIKELETS PER NODE
134 **1 (sessile or pedicelled)**
135 **2 (one sessile and one pedicelled)**
136 **2 (both sessile or pedicelled)**
137 **3+ (all sessile and/or pedicelled)**

*SPIKELETS PER INFLORESCENCE
138 2-10
139 10-20
140 20-50
141 50-100
142 >100

*SPIKELET LENGTH
143 0.5-2 mm
144 2-5 mm
145 5-10 mm
146 10-20 mm
147 20-40 mm
148 >40 mm

*SPIKELET WIDTH
149 0.1-2 mm
150 2-4 mm
151 4-6 mm
152 >6 mm

SPIKELET COLOR
153 Pink, red or brown
154 Green
155 Black, gray or purple
156 White, cream or silvery
157 Pale\bright yellow or orange

*SPIKELET DISARTICULATION (separating joint from joint at maturity)
158 At the base of the spikelet
159 Above the glume (between the florets)
160 Below the branches or with the rachis joint or with bristles

*BISEXUAL OR FEMALE FLOWERS PER SPIKELET
161 1
162 2-3
163 4-10
164 11-20
165 >20

*GLUME NUMBER AND CONDITION
166 Absent or poorly developed
167 1 per spikelet
168 2+ per spikelet
169 First and second glumes subequal or equal
170 First and second glumes unequal
171 First glume shorter than first lemma
172 First glume equalling or longer than first lemma
173 Second glume shorter than first lemma
174 Second glume equalling or longer than first lemma

SECOND GLUME CONDITION
175 **0- or 1-nerved**
176 **2 to 5-nerved**
177 **7+ nerved**
178 **Hairy or rough on the back or margins**
179 **Essentially glabrous** (without hairs)

SECOND GLUME APEX
180 **Obtuse** (margins forming a terminal angle >90 degrees) or **truncate** (cut squarely across)
181 **Acute** (margins form a terminal angle of 45-90 degrees)
182 **Acuminate** (margins from a terminal angle of <45 degrees), **attenuate** (slenderly tapering or prolonged, more gradually than acuminate, and becoming very narrow or slender) or **caudate** (having a slender, tail-like appendage)
183 **Mucronate** (with a short, small abrupt tip), **aristate** (awn or bristle tipped) or **cuspidate** (tipped with a short, rigid point)
184 **Toothed,lobed or erose** (irregularly toothed as if gnawed)
185 **Awned** (bristle-like appendage)
186 **Unawned**

*FERTILE LEMMA CONDITION

187 **Firm** (coriaceous or cartilaginous)
188 **Chartaceous** (texture of stiff writing paper), **membranous** (thin, soft, and pliable) **or hyaline** (colorless, transparent, or translucent)
189 **Margins involute** (margin rolled inward) **or revolute** (margin rolled toward lower side of lemma)
190 **Margins flat**
191 **Rough or hairy on the back, keel or margins**
192 **Glabrous or nearly glabrous throughout** (without hairs)
193 **Body ovate** (egg shaped, broadest below middle), **lanceolate** (broadened at base and tapering toward apex) **or oblong** (sides parallel and length two to three times width)
194 **Body obovate** (inverse of ovate, with broadest half above middle and narrower end toward base), **elliptic** (broadest point midway between ends and width about one-half length) **or rotund** (round)
195 **Back rounded**
196 **Back keeled**
197 **Apex truncate** (cut squarely across), **obtuse** (margins forming a terminal angle >90 degrees) **or rounded**
198 **Apex acute** (margins form a terminal angle of 45-90 degrees)
199 **Apex acuminate** (margins form a terminal angle of <45 degrees)
200 **Apex retuse** (shallow notch), **bifid** (two-cleft to about middle), **toothed or lobed**
201 **Apex mucronate** (with a short, small abrupt tip), **aristate** (awn- or bristle-tipped), **or cuspidate** (tipped with a sharp, firm point)
202 **Base with hairy or smooth callus** (hardened thickening)

*FERTILE LEMMA AWN NUMBER, ARRANGEMENT AND LENGTH

203 **0**
204 **1**
205 **2+**
206 **From an unnotched apex**
207 **From a notched apex**
208 **From the back**
209 **Awn ascending or straight**
210 **Awn bent or twisted**
211 **Longest awn < 0.5 cm long**
212 **Longest awn 0.5-1 cm long**
213 **Longest awn 1-3 cm long**
214 **Longest awn >3 cm long**

*FERTILE LEMMA NERVE NUMBER

215 **1**
216 **2-3**
217 **4-8**
218 **9+**

*FERTILE LEMMA LENGTH
219 0.5-1 mm
220 1-2 mm
221 2-3.5 mm
222 3.5-5 mm
223 5-10 mm
224 >10 mm

*STAMENS PER FLOWER
225 1
226 2
227 3
228 4-6

*ANTHER LENGTH
229 0.2-0.5 mm
230 0.5-1 mm
231 1-2 mm
232 2-3 mm
233 3-5 mm
234 >5 mm

ANTHER COLOR
235 Black or purple
236 Pink, red or brown
237 Yellow or orange
238 White or creamy

*STIGMA NUMBER
239 2
240 3

STIGMA COLOR
241 Black or purple
242 Pink, red or brown
243 White or creamy
244 Yellow

FRUIT VESTITURE
245 Glabrous (without hairs)
246 Body or apex hairy

FRUIT COLOR
247 White or creamy
248 Black, purple or gray
249 Greenish or yellow
250 Pink, red or brown

FRUIT LENGTH
251 0.5-1 mm
252 1-3 mm
253 >3 mm

Grass Key, 532 taxa.

1 Agrostis aequivalvis
2 Agrostis alascana
3 Agrostis avenacea
4 Agrostis canina
5 Agrostis clavata
6 Agrostis exarata
7 Agrostis gigantea
8 Agrostis humilis
9 Agrostis hyemalis
10 Agrostis idahoensis
11 Agrostis longiligula
12 Agrostis mertensii
13 Agrostis microphylla
14 Agrostis oregonensis
15 Agrostis perennans
16 Agrostis scabra
17 Agrostis stolonifera
18 Agrostis tandilensis
19 Agrostis thurberiana
20 Agrostis vinealis
21 Aira caryophyllea
22 Allolepis texana
23 Alopecurus aequalis
24 Alopecurus arundinaceus
25 Alopecurus borealis
26 Alopecurus carolinianus
27 Alopecurus geniculatus
28 Alopecurus myosuroides
29 Alopecurus pratensis
30 Alopecurus saccatus
31 Ammophila arenaria
32 Ammophila breviligulata
33 Amphicarpum muehlenbergianum
34 Amphicarpum purshii
35 Andropogon arctatus
36 Andropogon brachystachyus
37 Andropogon floridanus
38 Andropogon gerardii
39 Andropogon glomeratus
40 Andropogon gyrans
41 Andropogon hallii
42 Andropogon mohrii
43 Andropogon ternarius
44 Andropogon virginicus
45 Anthaenantia rufa
46 Anthaenantia villosa
47 Anthoxanthum odoratum
48 Arctagrostis latifolia
49 Arctophila fulva
50 Aristida dichotoma

51 Aristida longespica
52 Aristida patula
53 Aristida purpurascens
54 Aristida simpliciflora
55 Aristida spiciformis
56 Aristida stricta
57 Arrhenatherum elatius
58 Arthraxon hispidus
59 Arundinaria gigantea
60 Arundo donax
61 Axonopus compressus
62 Axonopus fissifolius
63 Axonopus furcatus
64 Bambusa vulgaris
65 Beckmannia syzigachne
66 Bothriochloa bladhii
67 Brachiaria fasciculata
68 Brachiaria mutica
69 Brachiaria plantaginea
70 Brachiaria platyphylla
71 Briza media
72 Briza minor
73 Bromus canadensis
74 Bromus ciliatus
75 Bromus hordeaceus
76 Bromus japonicus
77 Bromus kalmii
78 Bromus latiglumis
79 Bromus rubens
80 Bromus vulgaris
81 Buchloe dactyloides
82 Calamagrostis bolanderi
83 Calamagrostis canadensis
84 Calamagrostis cinnoides
85 Calamagrostis crassiglumis
86 Calamagrostis deschampsioides
87 Calamagrostis epigeios
88 Calamagrostis holmii
89 Calamagrostis lapponica
90 Calamagrostis nutkaensis
91 Calamagrostis perplexa
92 Calamagrostis pickeringii
93 Calamagrostis scopulorum
94 Calamagrostis scribneri
95 Calamagrostis stricta
96 Calamovilfa arcuata
97 Calamovilfa brevipilis
98 Calamovilfa curtissii
99 Catabrosa aquatica
100 Cathestecum erectum
101 Cenchrus myosuroides
102 Cenchrus tribuloides

103 Chasmanthium latifolium
104 Chasmanthium laxum
105 Chasmanthium nitidum
106 Chasmanthium ornithorhynchum
107 Chloris barbata
108 Chloris ciliata
109 Chloris crinita
110 Chloris radiata
111 Cinna arundinacea
112 Cinna latifolia
113 Coelorachis cylindrica
114 Coelorachis rugosa
115 Coelorachis tessellata
116 Coelorachis tuberculosa
117 Coix lacryma-jobi
118 Coleanthus subtilis
119 Crypsis alopecuroides
120 Crypsis schoenoides
121 Crypsis vaginiflora
122 Ctenium aromaticum
123 Ctenium floridanum
124 Cynodon dactylon
125 Cynosurus cristatus
126 Dactylis glomerata
127 Danthonia californica
128 Danthonia compressa
129 Danthonia intermedia
130 Danthonia sericea
131 Deschampsia cespitosa
132 Deschampsia danthonioides
133 Deschampsia elongata
134 Dichanthelium aciculare
135 Dichanthelium acuminatum
136 Dichanthelium boreale
137 Dichanthelium clandestinum
138 Dichanthelium commutatum
139 Dichanthelium consanguineum
140 Dichanthelium dichotomum
141 Dichanthelium erectifolium
142 Dichanthelium latifolium
143 Dichanthelium laxiflorum
144 Dichanthelium leibergii
145 Dichanthelium oligosanthes
146 Dichanthelium ovale
147 Dichanthelium ravenelii
148 Dichanthelium sabulorum
149 Dichanthelium scabriusculum
150 Dichanthelium scoparium
151 Dichanthelium sphaerocarpon
152 Dichanthelium strigosum
153 Digitaria ciliaris
154 Digitaria eriantha

155 Digitaria horizontalis
156 Digitaria insularis
157 Digitaria ischaemum
158 Digitaria sanguinalis
159 Digitaria serotina
160 Digitaria setigera
161 Digitaria violascens
162 Distichlis spicata
163 Dupontia fisheri
164 Echinochloa colona
165 Echinochloa crus-galli
166 Echinochloa crus-pavonis
167 Echinochloa muricata
168 Echinochloa paludigena
169 Echinochloa polystachya
170 Echinochloa walteri
171 Eleusine indica
172 Elymus alaskanus
173 Elymus canadensis
174 Elymus caninus
175 Elymus elymoides
176 Elymus glaucus
177 Elymus lanceolatus
178 Elymus macrourus
179 Elymus riparius
180 Elymus sibiricus
181 Elymus trachycaulus
182 Elymus villosus
183 Elymus virginicus
184 Elyonurus tripsacoides
185 Elytrigia pungens
186 Elytrigia repens
187 Eragrostis atrovirens
188 Eragrostis bahiensis
189 Eragrostis campestris
190 Eragrostis cilianensis
191 Eragrostis ciliaris
192 Eragrostis frankii
193 Eragrostis glomerata
194 Eragrostis hirsuta
195 Eragrostis hypnoides
196 Eragrostis lugens
197 Eragrostis mexicana
198 Eragrostis pectinacea
199 Eragrostis pilosa
200 Eragrostis prolifera
201 Eragrostis reptans
202 Eragrostis secundiflora
203 Eragrostis spectabilis
204 Eragrostis unioloides
205 Eragrostis virginica
206 Eriochloa acuminata

207 Eriochloa aristata
208 Eriochloa contracta
209 Eriochloa fatmensis
210 Eriochloa michauxii
211 Eriochloa polystachya
212 Eriochloa punctata
213 Eriochrysis cayennensis
214 Erioneuron grandiflorum
215 Eustachys glauca
216 Eustachys neglecta
217 Eustachys petraea
218 Festuca altaica
219 Festuca arundinacea
220 Festuca californica
221 Festuca paradoxa
222 Festuca pratensis
223 Festuca rubra
224 Festuca subulata
225 Festuca subverticillata
226 Gastridium ventricosum
227 Glyceria acutiflora
228 Glyceria borealis
229 Glyceria canadensis
230 Glyceria elata
231 Glyceria fluitans
232 Glyceria leptostachya
233 Glyceria maxima
234 Glyceria melicaria
235 Glyceria nubigena
236 Glyceria obtusa
237 Glyceria occidentalis
238 Glyceria pulchella
239 Glyceria septentrionalis
240 Glyceria striata
241 Gymnopogon brevifolius
242 Gymnopogon chapmanianus
243 Gynerium sagittatum
244 Hainardia cylindrica
245 Hemarthria altissima
246 Hierochloe hirta
247 Hierochloe odorata
248 Hierochloe pauciflora
249 Holcus lanatus
250 Hordeum arizonicum
251 Hordeum brachyantherum
252 Hordeum californicum
253 Hordeum depressum
254 Hordeum jubatum
255 Hordeum marinum
256 Hordeum murinum
257 Hordeum pusillum
258 Hymenachne amplexicaulis

259 Leersia hexandra
260 Leersia lenticularis
261 Leersia monandra
262 Leersia oryzoides
263 Leersia virginica
264 Leptochloa fascicularis
265 Leptochloa filiformis
266 Leptochloa nealleyi
267 Leptochloa panicoides
268 Leptochloa scabra
269 Leptochloa uninervia
270 Leptochloa virgata
271 Leptochloa viscida
272 Leymus arenarius
273 Leymus cinereus
274 Leymus condensatus
275 Leymus innovatus
276 Leymus triticoides
277 Lolium perenne
278 Lophochlaena californica
279 Lophochlaena oregona
280 Lophochlaena refracta
281 Luziola bahiensis
282 Luziola fluitans
283 Luziola peruviana
284 Melica bulbosa
285 Melica spectabilis
286 Microstegium vimineum
287 Miscanthus sinensis
288 Monanthochloe littoralis
289 Muhlenbergia andina
290 Muhlenbergia asperifolia
291 Muhlenbergia californica
292 Muhlenbergia capillaris
293 Muhlenbergia eludens
294 Muhlenbergia filiformis
295 Muhlenbergia frondosa
296 Muhlenbergia glomerata
297 Muhlenbergia lindheimeri
298 Muhlenbergia mexicana
299 Muhlenbergia minutissima
300 Muhlenbergia montana
301 Muhlenbergia pectinata
302 Muhlenbergia racemosa
303 Muhlenbergia reverchonii
304 Muhlenbergia richardsonis
305 Muhlenbergia rigens
306 Muhlenbergia schreberi
307 Muhlenbergia sylvatica
308 Muhlenbergia torreyana
309 Muhlenbergia uniflora
310 Muhlenbergia utilis

311 Muhlenbergia wolfii
312 Muhlenbergia wrightii
313 Neostapfia colusana
314 Neyraudia reynaudiana
315 Olyra latifolia
316 Oplismenus hirtellus
317 Orcuttia californica
318 Orcuttia pilosa
319 Orcuttia tenuis
320 Oryza sativa
321 Oryzopsis hymenoides
322 Panicum abscissum
323 Panicum amarum
324 Panicum anceps
325 Panicum brachyanthum
326 Panicum capillare
327 Panicum dichotomiflorum
328 Panicum diffusum
329 Panicum flexile
330 Panicum gattingeri
331 Panicum hallii
332 Panicum hemitomon
333 Panicum hillmanii
334 Panicum hirstii
335 Panicum maximum
336 Panicum obtusum
337 Panicum philadelphicum
338 Panicum pilcomayense
339 Panicum repens
340 Panicum rigidulum
341 Panicum tenerum
342 Panicum verrucosum
343 Panicum virgatum
344 Parapholis incurva
345 Pascopyrum smithii
346 Paspalidium geminatum
347 Paspalum acuminatum
348 Paspalum bifidum
349 Paspalum blodgettii
350 Paspalum boscianum
351 Paspalum caespitosum
352 Paspalum conjugatum
353 Paspalum dilatatum
354 Paspalum dissectum
355 Paspalum distichum
356 Paspalum fimbriatum
357 Paspalum floridanum
358 Paspalum fluitans
359 Paspalum hartwegianum
360 Paspalum hydrophylum
361 Paspalum laeve
362 Paspalum lividum

363 Paspalum monostachyum
364 Paspalum notatum
365 Paspalum plicatulum
366 Paspalum praecox
367 Paspalum pubiflorum
368 Paspalum racemosum
369 Paspalum scrobiculatum
370 Paspalum setaceum
371 Paspalum urvillei
372 Paspalum vaginatum
373 Paspalum virgatum
374 Pennisetum clandestinum
375 Pennisetum glaucum
376 Pennisetum purpureum
377 Phalaris angusta
378 Phalaris aquatica
379 Phalaris arundinacea
380 Phalaris brachystachys
381 Phalaris californica
382 Phalaris canariensis
383 Phalaris caroliniana
384 Phalaris lemmonii
385 Phanopyrum gymnocarpon
386 Pharus latifolius
387 Phippsia algida
388 Phleum alpinum
389 Phleum pratense
390 Phragmites australis
391 Piptochaetium avenaceum
392 Poa abbreviata
393 Poa alpina
394 Poa alsodes
395 Poa annua
396 Poa arctica
397 Poa arida
398 Poa atropurpurea
399 Poa autumnalis
400 Poa chapmaniana
401 Poa compressa
402 Poa curta
403 Poa douglasii
404 Poa eminens
405 Poa fendleriana
406 Poa leibergii
407 Poa leptocoma
408 Poa macrocalyx
409 Poa marcida
410 Poa napensis
411 Poa nemoralis
412 Poa nervosa
413 Poa paludigena
414 Poa palustris

415 Poa pratensis
416 Poa pseudoabbreviata
417 Poa secunda
418 Poa sierrae
419 Poa stenantha
420 Poa sylvestris
421 Poa trivialis
422 Poa unilateralis
423 Polypogon elongatus
424 Polypogon interruptus
425 Polypogon maritimus
426 Polypogon monspeliensis
427 Polypogon viridis
428 Psathyrostachys juncea
429 Pseudoroegneria spicata
430 Puccinellia andersonii
431 Puccinellia angustata
432 Puccinellia arctica
433 Puccinellia distans
434 Puccinellia fasciculata
435 Puccinellia grandis
436 Puccinellia hultenii
437 Puccinellia interior
438 Puccinellia kamtschatica
439 Puccinellia kurilensis
440 Puccinellia lemmonii
441 Puccinellia lucida
442 Puccinellia maritima
443 Puccinellia nutkaensis
444 Puccinellia nuttalliana
445 Puccinellia parishii
446 Puccinellia phryganodes
447 Puccinellia simplex
448 Puccinellia tenella
449 Puccinellia vaginata
450 Puccinellia wrightii
451 Reimarochloa oligostachya
452 Saccharum alopecuroides
453 Saccharum baldwinii
454 Saccharum brevibarbe
455 Saccharum contortum
456 Saccharum giganteum
457 Saccharum officinarum
458 Saccharum ravennae
459 Sacciolepis indica
460 Sacciolepis striata
461 Schizachne purpurascens
462 Schizachyrium maritimum
463 Schizachyrium rhizomatum
464 Schizachyrium scoparium
465 Schizachyrium stoloniferum
466 Scolochloa festucacea

467 Setaria faberi
468 Setaria italica
469 Setaria macrosperma
470 Setaria magna
471 Setaria palmifolia
472 Setaria parviflora
473 Setaria sphacelata
474 Setaria verticillata
475 Sorghastrum nutans
476 Sorghastrum secundum
477 Sorghum bicolor
478 Sorghum halepense
479 Spartina alterniflora
480 Spartina bakeri
481 Spartina cynosuroides
482 Spartina foliosa
483 Spartina gracilis
484 Spartina patens
485 Spartina pectinata
486 Spartina spartinae
487 Sphenopholis filiformis
488 Sphenopholis obtusata
489 Sphenopholis pensylvanica
490 Sporobolus airoides
491 Sporobolus asper
492 Sporobolus cryptandrus
493 Sporobolus curtissii
494 Sporobolus domingensis
495 Sporobolus flexuosus
496 Sporobolus floridanus
497 Sporobolus giganteus
498 Sporobolus heterolepis
499 Sporobolus indicus
500 Sporobolus jacquemontii
501 Sporobolus neglectus
502 Sporobolus pyramidatus
503 Sporobolus teretifolius
504 Sporobolus texanus
505 Sporobolus vaginiflorus
506 Sporobolus virginicus
507 Steinchisma hians
508 Stenotaphrum secundatum
509 Stipa diegoensis
510 Stipa richardsonii
511 Torreyochloa californica
512 Torreyochloa pallida
513 Torreyochloa pauciflora
514 Tridens albescens
515 Tridens ambiguus
516 Tridens flavus
517 Tridens strictus
518 Tripsacum dactyloides

519 Trisetum cernuum
520 Trisetum melicoides
521 Trisetum sibiricum
522 Trisetum spicatum
523 Trisetum wolfii
524 Tuctoria greenei
525 Uniola paniculata
526 Vahlodea atropurpurea
527 Vulpia bromoides
528 Vulpia myuros
529 Vulpia octoflora
530 Zizania aquatica
531 Zizania texana
532 Zizaniopsis miliacea

CYPER

General	Stem	Leaf	Flower/ Inflorescence	Fruit
Geography 294–323	Size 25–39	Size 56–68	Position 78–79	Shape 238–240
Habit 1–3 13	Number 9–10	Venation 48–55	Size 90–102	Number 227–228
Root/ Rhizome 4–8	Form 11–12 14–20 24	Position 40–43	Type 103–110	Color 229–232
	Vestiture 21–23	Number 44–47	Primary Ray 111–115	Surface 223 233–237
		Sheath 69–74	Bract 80–89	Apex 241–249
		Ligule 75–76	Stigma 213–214	Size 250–253
			Spikelet 120–154	Position 255–259
			Perianth Bristle/Scale 77 160–212	
			Glume 155–159	
			Stamen 218–222	

519 Trisetum cernuum
520 Trisetum melicoides
521 Trisetum sibiricum
522 Trisetum spicatum
523 Trisetum wolfii
524 Tuctoria greenei
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General	Stem	Leaf	Flower/ Inflorescence	Fruit
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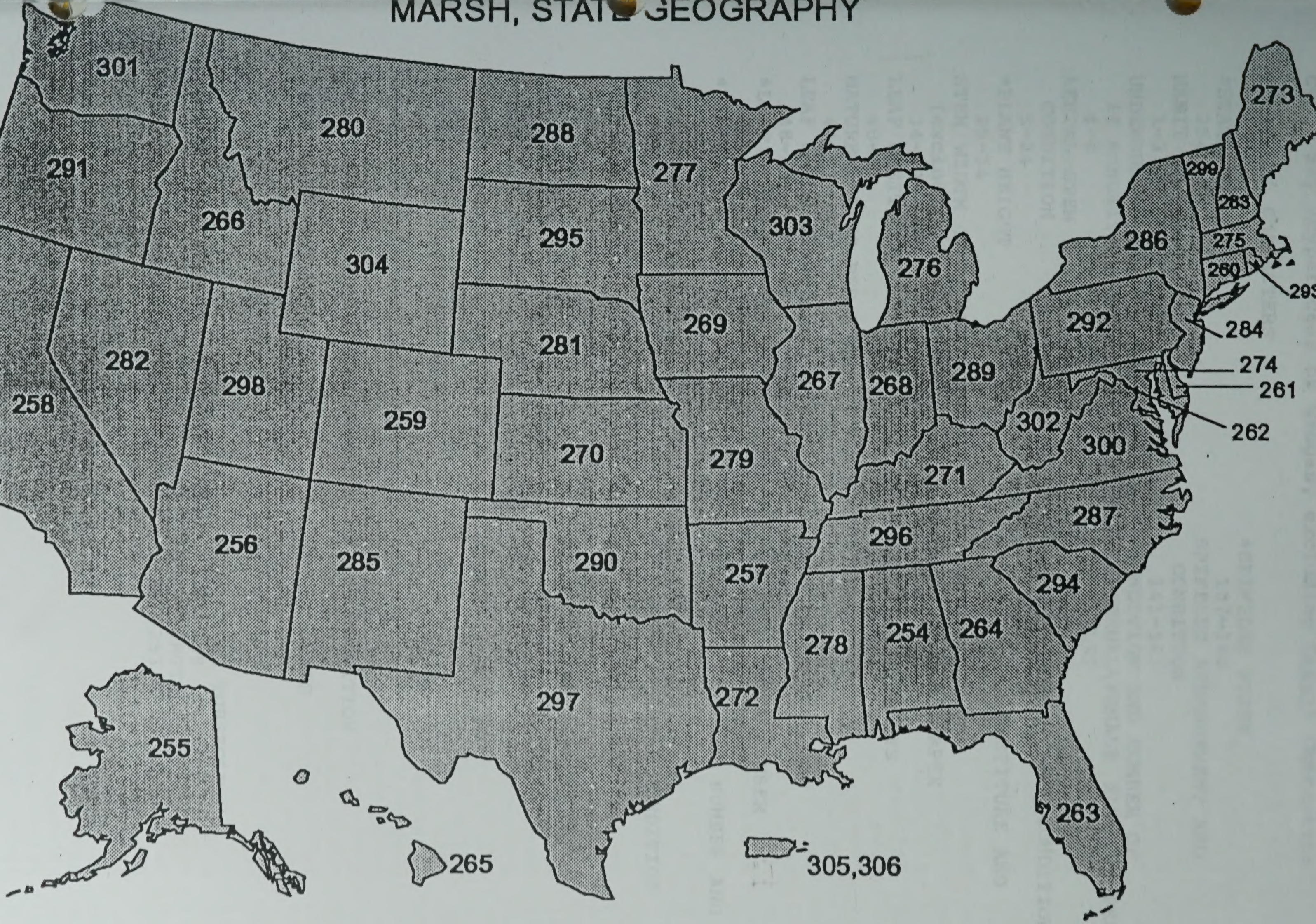
			Spikelet 120–154	Position 225–226
			Perianth Bristle/Scale 77 189–212	
			Glume 155–188	
			Stamen 215–222	

MARSH, STATE GEOGRAPHY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Cyper Key (Cyperaceae or sedges, excluding Carex) Characters

*CRITICAL CHARACTERS

*STATE GEOGRAPHY
254-323
HABIT
1-3
UNDERGROUND PARTS (skip this if annual\biennial)
4-8
AERIAL STEM NUMBER AND CONDITION
9-24
*PLANT HEIGHT
25-34
STEM WIDTH 1 cm ABOVE BASE (excluding leaf sheath)
34-39
LEAF POSITION
40-43
MATURE LEAVES PER STEM
44-47
LEAF BLADE SHAPE AND VESTITURE
48-55
*LEAF BLADE LENGTH
56-60
*LEAF BLADE WIDTH
61-68
LEAF SHEATH COLOR
69-71
LEAF SHEATH APEX
72-74
LIGULE
75, 76
*INFLORESCENCE CONDITION AND POSITION
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NUMBER AND NATURE OF INVOLUCRAL BRACTS OF TERMINAL INFLORESCENCE
80-92
*TERMINAL INFLORESCENCE LENGTH
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*TERMINAL INFLORESCENCE WIDTH
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*INFLORESCENCE TYPE
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*PRIMARY RAY PEDUNCLE LENGTH
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*SPIKELETS PER STEM
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*SPIKELETS PER PRIMARY RAY (including branches)
127-131
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137-140
SPIKELET ARRANGEMENT AND CONDITION
141-147
*CONDITION AND NUMBER OF BISEXUAL\FEMALE FLOWERS PER SPIKELET
148-154
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155-161
GLUME COLOR, VESTITURE AND CONDITION
162-171
GLUME BODY AND APEX
172-180
GLUME RIBS\NERVES
181-184
*GLUME LENGTH
185-188
HYPOGYNIUM
189-194
PERIANTH SCALE NUMBER
195-197
*PERIANTH BRISTLE NUMBER AND COLOR
198-205
*PERIANTH BRISTLE CONDITION
206-212
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213, 214
*STAMENS PER FLOWER
215-217
*ANTHER LENGTH
218-222
FRUIT
223-226
FRUIT PER SPIKELET
227, 228
FRUIT COLOR
229-232
FRUIT CONDITION
233-237
*FRUIT SHAPE
238-240
FRUIT APEX
241-245
FRUIT APEX TUBERCLE
246-249
FRUIT LENGTH
250-253

Cyper Key (Cyperaceae or sedges, excluding Carex), 323 Characters

*Critical Characters

*STATE GEOGRAPHY

254	**Alabama**
255	**Alaska**
256	**Arizona**
257	**Arkansas**
258	**California**
259	**Colorado**
260	**Connecticut**
261	**Delaware**
262	**District of Columbia**
263	**Florida**
264	**Georgia**
265	**Hawaii**
266	**Idaho**
267	**Illinois**
268	**Indiana**
269	**Iowa**
270	**Kansas**
271	**Kentucky**
272	**Louisiana**
273	**Maine**
274	**Maryland**
275	**Massachusetts**
276	**Michigan**
277	**Minnesota**
278	**Mississippi**
279	**Missouri**
280	**Montana**
281	**Nebraska**
282	**Nevada**
283	**New Hampshire**
284	**New Jersey**
285	**New Mexico**
286	**New York**
287	**North Carolina**
288	**North Dakota**
289	**Ohio**
290	**Oklahoma**
291	**Oregon**
292	**Pennsylvania**
293	**Rhode Island**
294	**South Carolina**
295	**South Dakota**
296	**Tennessee**
297	**Texas**
298	**Utah**
299	**Vermont**
300	**Virginia**
301	**Washington**
302	**West Virginia**
303	**Wisconsin**
304	**Wyoming**
305	**Puerto Rico**
306	**Virgin Islands**
307	**Alberta**
308	**British Columbia**
309	**Franklin**

310 Keewatin
311 Labrador
312 MacKenzie
313 Manitoba
314 New Brunswick
315 Newfoundland
316 Nova Scotia
317 Ontario
318 Prince Edward Island
319 Quebec
320 Saskatchewan
321 Yukon Territory
322 Greenland (Denmark)
323 St. Pierre and Miquelon Islands (France

HABIT
1 **Annual or Biennial** (living for one or two years)
2 **Perennial** (living several to many seasons)
3 **Mat-forming or colonial** (in clumps)

UNDERGROUND PARTS (skip if annual\biennial)
4 **Rhizome** (a creeping, underground stem with roots often produced from nodes) **>10 cm**
5 **Rhizome absent to <10 cm or knotty**
6 **Stolon** (a shoot that bends to the ground and takes root or a horizontal stem at or below the surface of the ground that gives rise to a new plant at the tip) **present**
7 **Corm** (an enlarged solid fleshy base of a stem with scales), **tuber** (a thick storage stem with an enlarged fleshy base, usually upright), **or bulb** (an underground leaf bud with thickened scales) **present**
8 **Roots thick (>1 mm)**

AERIAL STEM NUMBER AND CONDITION
9 **Solitary**
10 **2+ (caespitose)**
11 **Branched (upward)**
12 **Unbranched**
13 **Floating or arching (sometimes rooting from tip)**
14 **Decumbent** (reclining with tips ascending) **and/or rooting at lower nodes**
15 **Erect** (stem upright)
16 **Ascending, spreading or nodding** (hanging down)
17 **Surface convex, flat or compressed** (concave)
18 **4+ angled, twisted or winged**
19 **3-angled**
20 **Round**
21 **Glabrous** (without hairs)
22 **Rough** (scabrous or hispid) **(especially noticeable below inflorescence)**
23 **Papillate** (bearing minute, nipple-shaped projections) **or pubescent** (covered with soft, short, down-like hairs)
24 **Jointed, septate** (partitioned by walls), **or spongy**

*PLANT HEIGHT (includes inflorescence)

25 **1-5 cm**
26 **5-10 cm** (2-4 in.)
27 **10-20 cm** (4-8 in.)
28 **20-30 cm** (8-12 in.)
29 **30-50 cm** (12-20 in.)
30 **50-70 cm** (20-28 in.)
31 **70-100 cm** (28-40 in.)
32 **100-150 cm** (40-60 in.)
33 **150-200 cm** (60-80 in., 5-6 1/2 ft.)
34 **>200 cm** (6 1/2 ft.)

STEM WIDTH 1 cm ABOVE BASE (excluding leaf sheath)

35 **0.1-0.5 mm**
36 **0.5-2 mm**
37 **2-5 mm**
38 **5-10 mm**
39 **>10 mm**

LEAF POSITION

40 **Reduced or absent**
41 **Lower or upper leaves absent (sheaths present)**
42 **Cauline** (on stem)
43 **Basal or nearly so**

MATURE LEAVES PER STEM

44 **1-5**
45 **5-10**
46 **10-20**
47 **>20**

LEAF BLADE SHAPE AND VESTITURE

48 **Flat**
49 **Channelled, carinate** (keeled, with a sharp longitudinal ridge), **or plicate** (plated, folded like a fan)
50 **Terete** (round) **or capilliform** (hair-like)
51 **Revolute** (margin rolled under toward lower side of leaf) **or involute** (margin rolled toward upper side of leaf)
52 **Glabrous** (without hairs)
53 **Hairy**
54 **Margin serrulate** (finely saw-toothed, the sharp teeth pointing forward) **or spinulose** (with small spines over the surface)
55 **Partly colored**

*LEAF BLADE LENGTH

56 **1-5 cm**
57 **5-10 cm**
58 **10-20 cm**
59 **20-50 cm**
60 **>50 cm**

*LEAF BLADE WIDTH

61 0.1-0.5 mm
62 0.5-2 mm
63 2-5 mm
64 5-10 mm
65 10-15 mm
66 15-20 mm
67 20-30 mm
68 >30 mm

LEAF SHEATH COLOR

69 Yellow or green
70 Red or brown
71 Gray, pink or purple

LEAF SHEATH APEX

72 Truncate (cut squarely across)
73 Oblique (sheaths joining blade at dissimilar points)
74 Mucronate (with a short, small abrupt tip), acute (margins form a terminal angle of 45-90 degrees) or attenuate

LIGULE

75 Absent
76 Present

*INFLORESCENCE CONDITION AND POSITION

77 Cottony
78 Terminal
79 Axillary or appearing Lateral

NUMBER AND CONDITION OF INVOLUCRAL BRACTS OF TERMINAL INFLORESCENCE

80 0
81 1
82 2-5
83 5-10
84 >10
85 Erect or ascending
86 Spreading or recurved
87 Wholly green
88 Apically green and basally white or yellow
89 Setaceous (bristly or bristle-like) or scaly
90 Longer than inflorescence
91 Shorter than or equalling inflorescence
92 Auricled (ear-shaped) or sheathing

*TERMINAL INFLORESCENCE LENGTH (not including involucral bracts)

93 0.5-2 cm
94 2-5 cm
95 5-10 cm
96 10-20 cm
97 >20 cm

*TERMINAL INFLORESCENCE WIDTH (not including involucral bracts)
98 **0.2-2 cm**
99 **2-5 cm**
100 **5-10 cm**
101 **10-15 cm**
102 **>15 cm**

*INFLORESCENCE TYPE
103 **Single Spikelet**
104 **Solitary head**
105 **2+ heads or glomerules**
106 **Panicle** (a branched elongate inflorescence with two or more pedicelled flowers per branch)
107 **Racemiform** (an unbranched elongate inflorescence with pedicelled flowers) **or spiciform** (an unbranched, elongate inflorescence with sessile flowers)
108 **Umbellate or cymose** (a determinate inflorescence of various shapes or degrees of branches, but the oldest flower is always on the end of the branch)
109 **Primary rays** (more or less elongated branch or peduncle of an inflorescence) **present only**
110 **Secondary\tertiary rays present**

*PRIMARY RAY NUMBER AND CONDITION
111 **1-5**
112 **5-10**
113 **>10**
114 **All peduncled** (stalked)
115 **Lateral rays peduncled, central rays sessile** (without a stalk)

*PRIMARY RAY PEDUNCLE LENGTH
116 **0-5 cm**
117 **5-10 cm**
118 **10-15 cm**
119 **>15 cm**

*SPIKELETS PER STEM
120 **1**
121 **2-10**
122 **10-20**
123 **20-50**
124 **50-100**
125 **100-200**
126 **>200**

*SPIKELETS PER PRIMARY RAY (INCLUDING BRANCHES)
127 **2-5**
128 **5-10**
129 **10-20**
130 **20-50**
131 **>50**

*SPIKELET LENGTH
132 **1-5 mm**
133 **5-10 mm**
134 **10-20 mm**
135 **20-40 mm**
136 **>40 mm**

*SPIKELET WIDTH
137 **0.1-2 mm**
138 **2-4 mm**
139 **4-6 mm**
140 **>6 mm**

SPIKELET ARRANGEMENT AND CONDITION (in an inflorescence with more than 1 spikelet)
141 **Ascending or capitate** (aggregated into very dense clusters or heads)
142 **Pinnate**
143 **Male and Female spikelets mixed**
144 **Male and female spikelets in separate clusters**
145 **Sessile** (not stalked)
146 **Sessile and pedicelled**
147 **Pedicelled** (stalked)

*CONDITION AND NUMBER OF BISEXUAL\FEMALE FLOWERS PER SPIKELET
148 **Bisexual**
149 **Unisexual**
150 **1-3**
151 **4-10**
152 **10-20**
153 **20-40**
154 **>40**

GLUME ARRANGEMENT AND CONDITION
155 **Distichous** (an alternating arrangement with adjoining glumes on opposite sides, 2-ranked, flattened)
156 **Spirally imbricate** (overlapping, shingle-like, round)
157 **Deciduous (from the base)**
158 **Persistent**
159 **Lower 3+ glumes empty** (sterile)
160 **Cartilaginous** (firm and tough, but flexible)
161 **Membranous** (thin and rather soft) **or nearly so**

GLUME COLOR, VESTITURE, AND CONDITION
162 **Red or brown**
163 **Whitish, greenish or yellowish**
164 **Blackish, grayish or purplish**
165 **Brown or red-pigmented or -streaked**
166 **Purple-spotted or -stripped**
167 **Green-midribbed or -tipped**
168 **Hyaline-margined** (colorless, transparent, or translucent)
169 **Glabrous** (without hairs)
170 **Hairy, papillate, or ciliate** (fringed with fine hairs on margin)
171 **Body or apex curved**

GLUME BODY AND APEX

172 **Ovate** (egg-shaped, broadest below middle) **or lanceolate** (broadened at base and tapered toward apex)
173 **Elliptic** (broadest point midway between ends and wide about one-half length), **oblong** (sides parallel and length two to three times width) **or rotund**
174 **Obovate** (inverse of ovate, with broadest half above middle and narrower toward base)
175 **Keeled**
176 **Obtuse** (rounded, constricted abruptly at apex), **or rounded**
177 **Acute** (margins form a terminal angle of 45-90 degrees)
178 **Truncate** (cut squarely across), **retuse** (shallow notch), **or bifid** (two-cleft to about middle)
179 **Mucronate** (with a short, small abrupt tip) **or cuspidate** (tipped with a short, rigid point)
180 **Acuminate** (margins form a terminal angle of <45 degrees), **awned or aristate** (awn- or bristle-tipped)

GLUME RIBS\NERVES

181 **1**
182 **2-3**
183 **4-7**
184 **>7**

*GLUME LENGTH

185 **0.5-2 mm**
186 **2-3.5 mm**
187 **3.5-5 mm**
188 **>5 mm**

HYPOGYNIUM (a perianth-like structure subtending and usually enveloping the ovary)

189 **Absent**
190 **Discoid**
191 **Cupular or lobed**
192 **With tubercles (small warty nodules)**
193 **Smooth**
194 **Papillose** (minute, nipple-like projections)**-crustaceous** (crusted)

PERIANTH SCALE NUMBER

195 **0**
196 **1-2**
197 **3**

*PERIANTH BRISTLE NUMBER AND COLOR

198 **0**
199 **1-6**
200 **7-11**
201 **12-20**
201 **21-60**
203 **Black, Brown or Red**
204 **Yellow**
205 **White, gray or colorless**

*PERIANTH BRISTLE CONDITION
77 **Cottony**
206 **Longer than fruits**
207 **Equalling or shorter than fruits**
208 **Plumose** (feathery)
209 **Antrorsely** (directed forward or upward) **or laterally barbed**
210 **Retrorsely barbed** (directed back or downward)
211 **Smooth or barbed at apex**
212 **Contorted** (twisted or bent)

*STIGMA NUMBER
213 **2**
214 **3**

*STAMENS PER FLOWER
215 **1**
216 **2**
217 **3**

*ANTHER LENGTH
218 **0.2-0.5 mm**
219 **0.5-1 mm**
220 **1-2 mm**
221 **2-3 mm**
222 **3-7 mm**

FRUIT
223 **Enwrapped in a perigynium** (the sac or sheath enveloping the fruit and often appearing as though it were the ovary wall)
224 **Free**
225 **Pedicelled** (stalked)
226 **Sessile** (not stalked) **or subsessile**

FRUIT PER SPIKELET
227 **1-2**
228 **3+**

FRUIT COLOR
229 **White or ivory**
230 **Gray, purple or black**
231 **Greenish or yellow**
232 **Pink, red or brown**

FRUIT CONDITION
233 **Smooth**
234 **Transversely ridged**
235 **Longitudinally ridged**
236 **Papillate** (bearing minute, nipple-shaped projections), **tubercled** (warty nodules), **rugose** (wrinkled), **or reticulate** (net-veined)
237 **Punctate** (dotted with translucent pitted glands or colored dots) **or pitted**

*FRUIT SHAPE
238 **Flat, biconvex** (rounded on both surfaces) **or lenticular** (lens-shaped)
239 **3-gonous**
240 **Globose, ovoid or terete** (cylindrical, round in cross-section)

FRUIT APEX

241 **Blunt or acute** (margins form a terminal angle of 45-90 degrees)
242 **Mucronate** (with a short, small abrupt tip), **apiculate** (terminated abruptly in a little point), **or erect-beaked**
243 **Bent-beaked**
244 **Not tubercled**
245 **Tubercled** (warty nodules)

FRUIT APEX TUBERCLE

246 **Base constricted**
247 **Base contingent with fruit body**
248 **Shorter than fruit body**
249 **Equalling or longer than fruit body**

FRUIT LENGTH

250 **0.5-1 mm**
251 **1-1.5 mm**
252 **1.5-3 mm**
253 **>3 mm**

Cyper Key, 310 taxa.

1 Abildgaardia ovata
2 Bulbostylis barbata
3 Bulbostylis capillaris
4 Bulbostylis ciliatifolia
5 Bulbostylis funckii
6 Bulbostylis juncoides
7 Bulbostylis stenophylla
8 Bulbostylis warei
9 Cladium californicum
10 Cladium mariscoides
11 Cladium mariscus
12 Cyperus acuminatus
13 Cyperus aggregatus
14 Cyperus amabilis
15 Cyperus articulatus
16 Cyperus bipartitus
17 Cyperus compressus
18 Cyperus croceus
19 Cyperus cuspidatus
20 Cyperus dentatus
21 Cyperus diandrus
22 Cyperus difformis
23 Cyperus digitatus
24 Cyperus distans
25 Cyperus distinctus
26 Cyperus echinatus
27 Cyperus elegans
28 Cyperus eragrostis
29 Cyperus erythrorhizos
30 Cyperus esculentus
31 Cyperus fendlerianus
32 Cyperus filiculmis
33 Cyperus flavescens
34 Cyperus flavicomus
35 Cyperus fuscus
36 Cyperus giganteus
37 Cyperus granitophilus
38 Cyperus haspan
39 Cyperus involucratus
40 Cyperus iria
41 Cyperus laevigatus
42 Cyperus lancastriensis
43 Cyperus lanceolatus
44 Cyperus lecontei
45 Cyperus ligularis
46 Cyperus niger
47 Cyperus ochraceus
48 Cyperus odoratus
49 Cyperus onerosus
50 Cyperus oxylepis
51 Cyperus papyrus
52 Cyperus parishii
53 Cyperus phaeolepis
54 Cyperus pilosus
55 Cyperus planifolius
56 Cyperus polystachyos
57 Cyperus pringlei
58 Cyperus prolixus
59 Cyperus pseudovegetus

60 Cyperus pumilus
61 Cyperus reflexus
62 Cyperus refractus
63 Cyperus retrorsus
64 Cyperus rotundus
65 Cyperus schweinitzii
66 Cyperus serotinus
67 Cyperus seslerioides
68 Cyperus setigerus
69 Cyperus sphacelatus
70 Cyperus squarrosus
71 Cyperus strigosus
72 Cyperus surinamensis
73 Cyperus tenuis
74 Cyperus tetragonus
75 Cyperus thyrsiflorus
76 Cyperus unioloides
77 Cyperus virens
78 Dulichium arundinaceum
79 Eleocharis acicularis
80 Eleocharis acutangula
81 Eleocharis acutisquamata
82 Eleocharis albida
83 Eleocharis atropurpurea
84 Eleocharis austrotexana
85 Eleocharis baldwinii
86 Eleocharis bella
87 Eleocharis bolanderi
88 Eleocharis cellulosa
89 Eleocharis compressa
90 Eleocharis cylindrica
91 Eleocharis elongata
92 Eleocharis engelmannii
93 Eleocharis equisetoides
94 Eleocharis erythropoda
95 Eleocharis fallax
96 Eleocharis flavescens
97 Eleocharis geniculata
98 Eleocharis halophila
99 Eleocharis intermedia
100 Eleocharis interstincta
101 Eleocharis kamtschatica
102 Eleocharis lanceolata
103 Eleocharis melanocarpa
104 Eleocharis microcarpa
105 Eleocharis minima
106 Eleocharis montana
107 Eleocharis montevidensis
108 Eleocharis mutata
109 Eleocharis nana
110 Eleocharis nitida
111 Eleocharis obtusa
112 Eleocharis olivacea
113 Eleocharis ovata
114 Eleocharis pachycarpa
115 Eleocharis palustris
116 Eleocharis parishii
117 Eleocharis parvula
118 Eleocharis quadrangulata
119 Eleocharis quinqueflora
120 Eleocharis radicans

121 Eleocharis retroflexa
122 Eleocharis robbinsii
123 Eleocharis rostellata
124 Eleocharis setifolia
125 Eleocharis smallii
126 Eleocharis tenuis
127 Eleocharis tortilis
128 Eleocharis tricostata
129 Eleocharis tuberculosa
130 Eleocharis uniglumis
131 Eleocharis vivipara
132 Eleocharis wolfii
133 Eriophorum alpinum
134 Eriophorum angustifolium
135 Eriophorum brachyantherum
136 Eriophorum callitrix
137 Eriophorum chamissonis
138 Eriophorum cringerum
139 Eriophorum gracile
140 Eriophorum russeolum
141 Eriophorum scheuchzeri
142 Eriophorum tenellum
143 Eriophorum vaginatum
144 Eriophorum virginicum
145 Eriophorum viridicarinatum
146 Fimbristylis annua
147 Fimbristylis autumnalis
148 Fimbristylis caroliniana
149 Fimbristylis castanea
150 Fimbristylis complanata
151 Fimbristylis cymosa
152 Fimbristylis decipiens
153 Fimbristylis dichotoma
154 Fimbristylis ferruginea
155 Fimbristylis miliacea
156 Fimbristylis perpusilla
157 Fimbristylis puberula
158 Fimbristylis schoenoides
159 Fimbristylis spathacea
160 Fimbristylis thermalis
161 Fimbristylis tomentosa
162 Fimbristylis vahlii
163 Fuirena breviseta
164 Fuirena longa
165 Fuirena pumila
166 Fuirena scirpoidea
167 Fuirena simplex
168 Fuirena squarrosa
169 Kobresia myosuroides
170 Kobresia sibirica
171 Kobresia simpliciuscula
172 Kyllinga brevifolia
173 Kyllinga brevifolioides
174 Kyllinga odorata
175 Kyllinga pumila
176 Lipocarpha aristulata
177 Lipocarpha drummondii
178 Lipocarpha maculata
179 Lipocarpha micrantha
180 Lipocarpha microcephala
181 Lipocarpha occidentalis

182 Remirea maritima
183 Rhynchospora alba
184 Rhynchospora baldwinii
185 Rhynchospora brachychaeta
186 Rhynchospora breviseta
187 Rhynchospora caduca
188 Rhynchospora californica
189 Rhynchospora capillacea
190 Rhynchospora capitellata
191 Rhynchospora careyana
192 Rhynchospora cephalantha
193 Rhynchospora chalarocephala
194 Rhynchospora chapmanii
195 Rhynchospora ciliaris
196 Rhynchospora colorata
197 Rhynchospora compressa
198 Rhynchospora corniculata
199 Rhynchospora crinipes
200 Rhynchospora culixa
201 Rhynchospora curtissii
202 Rhynchospora decurrens
203 Rhynchospora divergens
204 Rhynchospora elliottii
205 Rhynchospora eximia
206 Rhynchospora fascicularis
207 Rhynchospora fernaldii
208 Rhynchospora filifolia
209 Rhynchospora floridensis
210 Rhynchospora fusca
211 Rhynchospora globularis
212 Rhynchospora glomerata
213 Rhynchospora gracilenta
214 Rhynchospora grayi
215 Rhynchospora harperi
216 Rhynchospora harveyi
217 Rhynchospora indianolensis
218 Rhynchospora inexpansa
219 Rhynchospora intermedia
220 Rhynchospora inundata
221 Rhynchospora knieskernii
222 Rhynchospora latifolia
223 Rhynchospora macra
224 Rhynchospora macrostachya
225 Rhynchospora microcarpa
226 Rhynchospora miliacea
227 Rhynchospora mixta
228 Rhynchospora nitens
229 Rhynchospora nivea
230 Rhynchospora odorata
231 Rhynchospora oligantha
232 Rhynchospora pallida
233 Rhynchospora perplexa
234 Rhynchospora plumosa
235 Rhynchospora punctata
236 Rhynchospora pusilla
237 Rhynchospora rariflora
238 Rhynchospora rugosa
239 Rhynchospora saxicola
240 Rhynchospora scirpoides
241 Rhynchospora solitaria
242 Rhynchospora stenophylla

243 Rhynchospora sulcata
244 Rhynchospora torreyana
245 Rhynchospora tracyi
246 Rhynchospora wrightiana
247 Schoenus nigricans
248 Scirpus acutus
249 Scirpus americanus
250 Scirpus ancistrochaetus
251 Scirpus atrocinctus
252 Scirpus atrovirens
253 Scirpus californicus
254 Scirpus cernuus
255 Scirpus cespitosus
256 Scirpus clementis
257 Scirpus clintonii
258 Scirpus congdonii
259 Scirpus cubensis
260 Scirpus cylindricus
261 Scirpus cyperinus
262 Scirpus deltarum
263 Scirpus diffusus
264 Scirpus divaricatus
265 Scirpus erectus
266 Scirpus etuberculatus
267 Scirpus expansus
268 Scirpus flaccidifolius
269 Scirpus fluviatilis
270 Scirpus georgianus
271 Scirpus hallii
272 Scirpus hattorianus
273 Scirpus heterochaetus
274 Scirpus juncoides
275 Scirpus koilolepis
276 Scirpus longii
277 Scirpus maritimus
278 Scirpus microcarpus
279 Scirpus molestus
280 Scirpus mucronatus
281 Scirpus nevadensis
282 Scirpus pallidus
283 Scirpus pedicellatus
284 Scirpus pendulus
285 Scirpus polyphyllus
286 Scirpus pungens
287 Scirpus purshianus
288 Scirpus robustus
289 Scirpus rollandii
290 Scirpus rufus
291 Scirpus saximontanus
292 Scirpus setaceus
293 Scirpus smithii
294 Scirpus subterminalis
295 Scirpus tabernaemontani
296 Scirpus torreyi
297 Scirpus triqueter
298 Scirpus tuberosus
299 Scleria baldwinii
300 Scleria ciliata
301 Scleria georgiana
302 Scleria hirtella
303 Scleria lithosperma

304 Scleria minor
305 Scleria oligantha
306 Scleria pauciflora
307 Scleria reticularis
308 Scleria triglomerata
309 Scleria verticillata
310 Websteria confervoides

CAREX

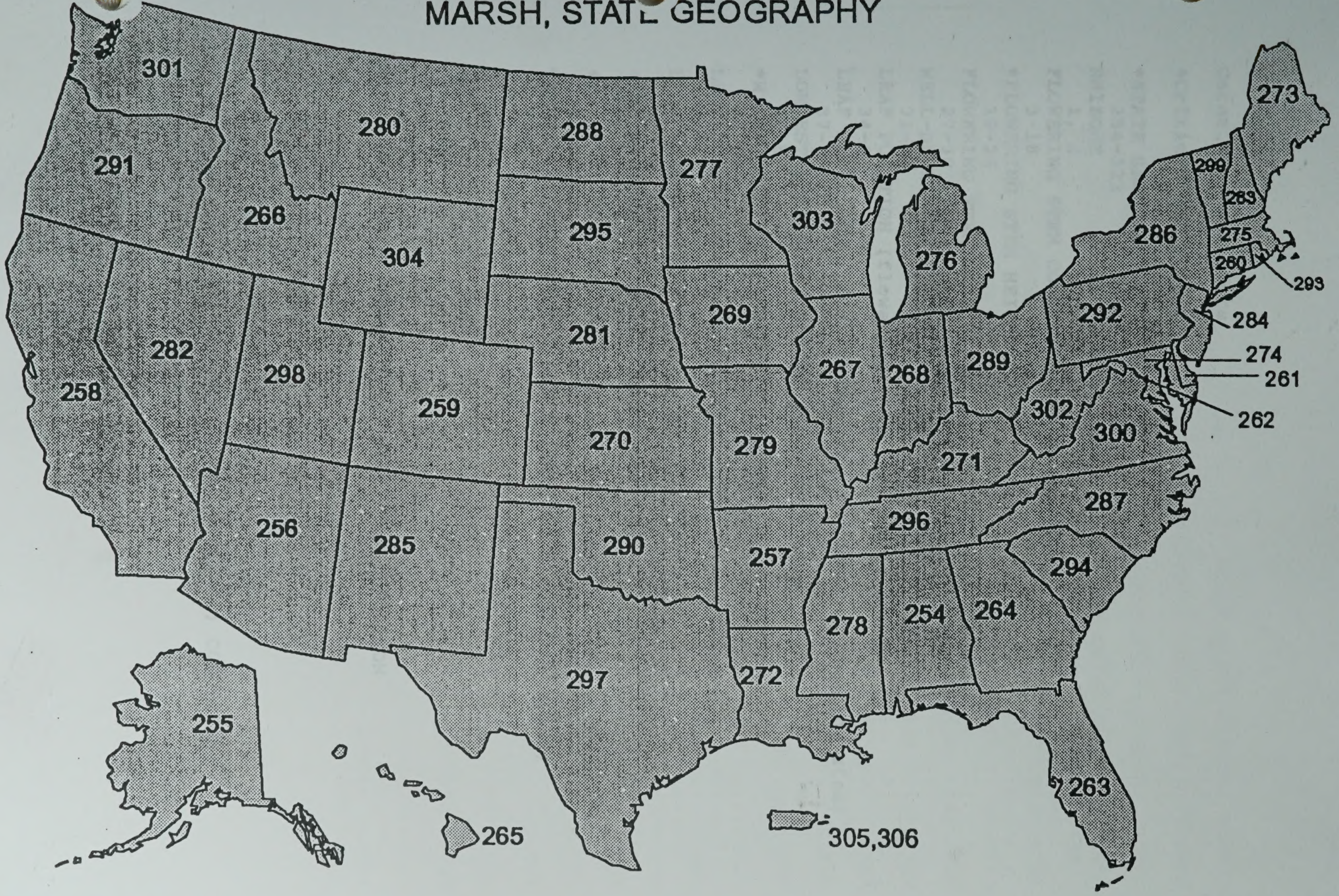
General	Stem	Leaf	Flower/ Inflorescence	Spike	Perigynium/ Pistillate Scale	Fruit
Geography 254–333	Size 19–30	Size 48–59	Position 71–73	Number 83–89	Number 171–177	Shape 243
Rhizome 1–2	Number/ Form 3–8	Number 31–33	Size 74–82	Terminal 90–117	Size 210–217 227–236	Size 244–249
	Shape 11–12	Position 9–10 16–17 34–36	Stigma/ Style 238–242	Lateral 118–147	Arrange-ment 178–181	
	Vestiture 13–15	Vestiture/ Surface 37–39 41–43 47	Anther 250–253		Shape 182–186	
	Pith 18	Sheath Vestiture/ Surface 60–67			Surface/ Vestiture 187–206 218–221	
	Base 9–10 16–17	Ligule 68–70			Margin 207–209	
					Base 222–226	
					Pistillate Scale 148–170	

[illegible] Solieria [illegible]
206 Solieria [illegible]
105 Solieria [illegible]
207 Solieria [illegible]
104 Solieria [illegible]
209 Solieria verticillata
210 [illegible] confervoides

CAREX

General	Stem	Leaf	Flower/ Inflorescence	Spike	Perigynium/ Pistillate Scale	Fruit
Geography 254–323	Size 19–30	Size 48–59	Position 71–73	Number 83–97	Number 171–177	Shape 243
Rhizome 1–2	Number/ Form 3–8	Number 31–33	Size 74–82	Terminal 98–117	Size 210–217 227–238	Size 244–249
	Shape 11–12	Position 9–10 16–17 34–36	Stigma/ Style 239–242	Lateral 118–147	Arrangement 178–181	
	Vestiture 13–15	Vestiture/ Surface 37–39 41–43 47	Anther 250–253		Shape 182–188	
	Pith 18	Sheath Vestiture/ Surface 60–67			Surface/ Vestiture 189–206 218–221	
	Base 9–10 16–17	Ligule 68–70			Margin 207–209	
					Base 222–226	
					Pistillate Scale 148–170	

MARSH, STATE GEOGRAPHY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Carex Key Characters

*Critical Characters

*STATE GEOGRAPHY
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RHIZOME
1, 2
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3-18
*FLOWERING STEM HEIGHT
19-26
FLOWERING STEM BASE WIDTH (excluding leaf sheaths)
27-30
WELL-DEVELOPED LEAVES ON FLOWERING STEM
31-33
LEAF POSITION (flowering stem; excluding bracts)
34-36
LEAF BLADE CONDITION, VESTITURE, AND COLOR (flowering stem)
37-47
LONGEST LEAF BLADE LENGTH (flowering stem)
48-53
*WIDEST LEAF BLADE WIDTH (flowering stem)
54-59
LEAF SHEATH CONDITION AND VESTITURE (flowering stem)
60-67
LEAF SHEATH LIGULE (flowering stem)
68-70
*INFLORESCENCE POSITION AND CONDITION
71-73
*TERMINAL INFLORESCENCE LENGTH (skip if a solitary spike)
74-78
TERMINAL INFLORESCENCE WIDTH (skip if a solitary spike)
79-82
*SPIKES PER STEM
83-87
*MALE SPIKES PER STEM
88-92
*FEMALE OR BISEXUAL SPIKES PER STEM
93-97
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98-101
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102-108
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109-112
TERMINAL SPIKE PEDUNCLE LENGTH
113-117
*LOWEST LATERAL SPIKE (skip if not distinct) CONDITION
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LOWEST LATERAL SPIKE LENGTH
123-130

LOWEST LATERAL SPIKE WIDTH
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136-140
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141-147
LOWEST LATERAL SPIKE PISTILLATE SCALES (color, shape and structure)
148-165
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166-170
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171-177
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178-181
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182-188
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189-206
PERIGYNIUM MARGINS OR LATERAL SIDES
207-209
*PERIGYNIUM BEAK LENGTH
210-217
PERIGYNIUM BEAK CONDITION
218-221
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222-226
*PERIGYNIUM LENGTH (including beak)
227-232
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233-238
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239, 240
*STIGMA NUMBER
241, 242
FRUIT BODY
243
FRUIT LENGTH
244-246
FRUIT WIDTH
247-249
ANTHER LENGTH
250-253

Carex Key, 323 Characters

*Critical Characters

*STATE GEOGRAPHY

254	**Alabama**
255	**Alaska**
256	**Arizona**
257	**Arkansas**
258	**California**
259	**Colorado**
260	**Connecticut**
261	**Delaware**
262	**District of Columbia**
263	**Florida**
264	**Georgia**
265	**Hawaii**
266	**Idaho**
267	**Illinois**
268	**Indiana**
269	**Iowa**
270	**Kansas**
271	**Kentucky**
272	**Louisiana**
273	**Maine**
274	**Maryland**
275	**Massachusetts**
276	**Michigan**
277	**Minnesota**
278	**Mississippi**
279	**Missouri**
280	**Montana**
281	**Nebraska**
282	**Nevada**
283	**New Hampshire**
284	**New Jersey**
285	**New Mexico**
286	**New York**
287	**North Carolina**
288	**North Dakota**
289	**Ohio**
290	**Oklahoma**
291	**Oregon**
292	**Pennsylvania**
293	**Rhode Island**
294	**South Carolina**
295	**South Dakota**
296	**Tennessee**
297	**Texas**
298	**Utah**
299	**Vermont**
300	**Virginia**

301 **Washington**
302 **West Virginia**
303 **Wisconsin**
304 **Wyoming**
305 **Puerto Rico**
306 **Virgin Islands**
307 **Alberta**
308 **British Columbia**
309 **Franklin**
310 **Keewatin**
311 **Labrador**
312 **MacKenzie**
313 **Manitoba**
314 **New Brunswick**
315 **Newfoundland**
316 **Nova Scotia**
317 **Ontario**
318 **Prince Edward Island**
319 **Quebec**
320 **Saskatchewan**
321 **Yukon Territory**
322 **Greenland (Denmark)**
323 **St. Pierre and Miquelon Islands (France)**

RHIZOME
1 **>10 cm long**
2 **Absent or <10 cm long**

FLOWERING STEM CONDITION AND ARRANGEMENT
3 **Single**
4 **Loosely clustered** (space between stems)
5 **Densely clustered** (minimal spaces between stems)
6 **Erect** (stem upright)
7 **Ascending, spreading or nodding** (hanging down)
8 **Decumbent** (reclining with tips ascending)
9 **Base Clothed with dried up Leaves of the previous year**
10 **Base not clothed with dried up Leaves**
11 **Obtusely 3-angled below the inflorescence**
12 **Sharply 3-angled below the Inflorescence**
13 **Glabrous** (without hairs)
14 **Hairy**
15 **Rough or papillate** (bearing minute, nipple-shaped projections) **on the angles at least upward**
16 **Phyllopodic** (lower leaves of culms with well-developed blades) **at base**
17 **Aphyllopodic** (lower leaves bladeless or nearly so) **or short-bladed at base**
18 **Hollow**

*FLOWERING STEM HEIGHT (includes inflorescence)

19 **1-10 cm**
20 **10-20 cm** (4-8 in.)
21 **20-30 cm** (8-12 in.)
22 **30-50 cm** (12-20 in.)
23 **50-70 cm** (20-28 in.)
24 **70-100 cm** (28-40 in.)
25 **100-150 cm** (>40-60 in.)
26 **>150 cm** (60 in., 5 ft.)

FLOWERING STEM BASE WIDTH (EXCLUDING LEAF SHEATHS)

27 **0.5-2 mm**
28 **2-5 mm**
29 **5-10 mm**
30 **>10 mm**

WELL-DEVELOPED LEAVES ON FLOWERING STEM

31 **1-5**
32 **5-10**
33 **>10**

LEAF POSITION (flowering stem; excluding bracts)

34 **Cauline** (pertaining to the stem) **from the base to the tip**
35 **Bunched below mid-stem**
36 **Scattered below mid-stem**

LEAF BLADE CONDITION, VESTITURE, AND COLOR (flowering stem)

37 **With 2 strong lateral veins on the upper surface**
38 **Glabrous** (without hairs)
39 **Hairy on one or both surfaces**
40 **Serrulate** (having very small marginal teeth)
41 **Green**
42 **Yellowish-green**
43 **Glaucous-green**
44 **Flat**
45 **Folded, channelled or canaliculate** (longitudinally channeled)
46 **Involute** (margin rolled inward toward upper side of leaf **or Revolute** (margin rolled under toward lower side of leaf)
47 **Septate** (partitioned by walls) **and/or nodulose** (with little knots or knobs)

LONGEST LEAF BLADE LENGTH (flowering stem)

48 **2-10 cm**
49 **10-15 cm** (4-6 in.)
50 **15-20 cm** (6-8 in.)
51 **20-40 cm** (8-16 in.)
52 **40-60 cm** (16-24 in.)
53 **>60 cm** (>24 in.)

*WIDEST LEAF BLADE WIDTH (flowering stem)

54 **0.2-1 mm**
55 **1-3 mm**
56 **3-5 mm**
57 **5-10 mm**
58 **10-15 mm**
59 **>15 mm**

LEAF SHEATH CONDITION AND VESTITURE (flowering stem)

60 **Cross-rugulose** (diminutively wrinkled) **ventrally**
61 **Hyaline** (transparent or translucent), **thin or white Ventrally**
62 **Streaked ventrally**
63 **Dotted or spotted ventrally**
64 **Septate** (partitioned by walls) **and/or nodulose** (with little knots or knobs) **dorsally**
65 **Glabrous** (without hairs)
66 **Hairy or rough**
67 **Lower sheaths filamentose**

LEAF SHEATH LIGULE (flowering stem)

68 **Longer than wide**
69 **As long as wide**
70 **Shorter than wide or inconspicuous**

*INFLORESCENCE POSITION AND CONDITION

71 **Terminal with 1 to many spikes** (axis unbranched)
72 **Terminal with many spikes** (compound; axis branched at base)
73 **Terminal & axillary**

*TERMINAL INFLORESCENCE LENGTH (skip if a solitary spike or if axillary spikes occur; includes all spikes from lowest lateral spike bract)

74 **1-2 cm**
75 **2-5 cm**
76 **5-10 cm** (2-4 in.)
77 **10-15 cm** (4-6 in.)
78 **15-25 cm** (6-10 in.)

TERMINAL INFLORESCENCE WIDTH (skip if a solitary spike)

79 **0.5-1 cm**
80 **1-2 cm**
81 **2-4 cm**
82 **>4 cm**

*SPIKES PER STEM

83 **1**
84 **2-5**
85 **5-10**
86 **10-15**
87 **>15**

*MALE SPIKES PER STEM
88 0
89 1
90 2-5
91 5-10
92 >10

*FEMALE OR BISEXUAL SPIKES PER STEM
93 0
94 1
95 2-5
96 5-10
97 >10

*TERMINAL SPIKE (skip if not distinct) CONDITION
98 Androgynous (tip with male flowers)
99 Gynandrous (tip with female flowers)
100 Male
101 Female

*TERMINAL SPIKE LENGTH (not including peduncle)
102 < 5 mm
103 0.5-1 cm
104 1-2 cm
105 2-3 cm
106 3-5 cm
107 5-8 cm
108 >8 cm (>3 in.)

*TERMINAL SPIKE WIDTH (at widest point)
109 1-3 mm
110 3-5 mm
111 5-10 mm
112 >10 mm

*TERMINAL SPIKE PEDUNCLE LENGTH
113 0-0.5 cm
114 0.5-2 cm
115 2-4 cm
116 4-6 cm
117 >6 cm

*LOWEST LATERAL SPIKE (skip if not distinct) CONDITION
118 Erect or ascending
119 Pendent (hanging down)
120 Female
121 Male or androgynous (tip with male flowers)
122 Gynandrous (tip with female flowers)

*LOWEST LATERAL SPIKE LENGTH

123 < 0.5 cm
124 0.5-1 cm
125 1-2 cm
126 2-3 cm
127 3-5 cm
128 5-8 cm
129 8-10 cm
130 >10 cm (>4in.)

*LOWEST LATERAL SPIKE WIDTH

131 1-3 mm
132 3-5 mm
133 5-10 mm
134 10-20 mm
135 >20 mm

LOWEST LATERAL SPIKE PEDUNCLE LENGTH

136 0-0.5 cm
137 0.5-2 cm
138 >2-4 cm
139 4-6 cm
140 > 6 cm

LOWEST LATERAL SPIKE BRACT

141 Leaf-like or setaceous (bearing bristles) >spike
142 Leaf-like or setaceous equalling the spike
143 Leaf-like or setaceous shorter than the spike
144 With dark base or auricles (an earlike appendage)
145 Long sheathing (>4 mm)
146 Not or short (<4 mm) sheathing
147 Absent or scale-like

LOWEST LATERAL SPIKE PISTILLATE SCALES (color, shape and structure)
148 **Green, light brown, yellowish-brown, white, or silvery**
149 **Medium brown or medium reddish-brown**
150 **Blackish-, purplish-, or dark reddish-brown, purple, Reddish-purple**
151 **Mid-region green**
152 **Mid-region non-green**
153 **Margins hyaline** (colorless, transparent, or translucent)
154 **Ovate** (egg-shaped, broadest below middle), **lanceolate** (broadened at base and tapering toward apex), **or oblong** (sides parallel and length two or three times width)
155 **Oblanceolate** (inverse of lanceolate with broadest half above middle and tapering toward base) **or obovate** (inverse of ovate, with broadest half above middle and narrower toward base)
156 **Elliptic** (broadest point midway between ends and width about one-half length), **ovoid** (broadly elliptical, a flattened circle usually more than twice as long as broad), **or orbicular** (round)
157 **Obtuse** (margins form a terminal angle >90 degrees) **or acute** (margins form a terminal angle of 45-90 degrees) **at apex**
158 **Acuminate** (margins form a terminal angle of <45 degrees) **at apex**
159 **Aristate** (awn or bristle tipped) **or cuspidate** (tipped with a short, rigid point) **at apex**
160 **Awned** (a terminal slender bristle) **at apex**
161 **Mucronate** (with a short, small abrupt tip), **truncate** (cut squarely across) **or retuse** (with a shallow rounded notch) **at apex**
162 **0- or 1-veined**
163 **3-veined**
164 **5+ veined**
165 **Rough or hairy on the back or ciliate** (having marginal hairs that form a fringe)

PISTILLATE SCALES IN RELATION TO MATURE PERIGYNIUM (the sac or sheath enveloping the fruit and often appearing as though it were the ovary wall)
166 **Scales as wide as or wider than mature perigynium**
167 **Scales narrower than mature perigynium**
168 **Scales shorter than mature perigynium**
169 **Scales as long as mature perigynium**
170 **Scales exceeding mature perigynium**

*NUMBER OF PERIGYNIA ON THE LOWEST OR ONLY SPIKE

171 **1-3**
172 **3-10**
173 **10-20**
174 **20-30**
175 **30-50**
176 **50-100**
177 **>100**

PERIGYNIA ARRANGEMENT ON THE LOWEST OR ONLY SPIKE

178 **Ascending or appressed** (pressed flat against another organ)
179 **Spreading or reflexed** (abruptly bent or turned downward)
180 **Close-dense**
181 **Loose or lax** (scattered)

PERIGYNIUM BODY SHAPE

182 **Linear** (long and narrow with parallel sides) **or subulate** (like an awl or prong)
183 **Ovate** (egg-shaped, broadest below middle), **lanceolate (broadened at base and tapering toward apex), or oblong** (sides parallel and length two to three times width)
184 **Oblanceolate** (inversely lanceolate), **obovate** (inverse of ovate with broadest half above middle and narrower toward base) **or obovoid** (egg shaped with broad end apical)
185 **Elliptic** (broadest point midway betweeen ends and width about one-half length), **ovoid** (oval), **or orbicular**
186 **Compressed** (flattened laterally)
187 **Thick or turgid** (swollen or inflated)
188 **Plano-** (flat on one side and rounded on the other), **concavo-** (hollow on one side and rounded on the other, like an eggshell), **or bi-convex** (rounded on both sides)

PERIGYNIUM CONDITION, VESTITURE, AND COLOR

189 **2-ribbed or 2-ridged abaxially** (pertaining to the side away from the axis)
190 **3-30 ribbed**
191 **Not nerved adaxially** (pertaining to the side toward the axis)
192 **Not nerved on both surfaces**
193 **3-10 nerved**
194 **10-20 nerved**
195 **20 nerved**
196 **Glabrous** (without hairs)
197 **Hairy**
198 **Papillate** (bearing minute, nipple-like projections) **or rough**
199 **Granular or punctate (white or red)**
200 **Purple- or red-dotted, -blotched, or -streaked**
201 **Greenish, greenish-white, greenish-brown or glaucous-green**
202 **Yellow, yellowish-green, yellowish-brown**
203 **Brown, reddish-brown, purplish-brown or reddish**
204 **Purple, reddish-purple, or black**
205 **Silvery or white**
206 **Colored differently above and below**

PERIGYNIUM MARGINS OR LATERAL SIDES

207 **Serrulate** (having very small marginal teeth) **at least at tip**
208 **Winged (at least in part) or sharp-margined**
209 **Round or angled**

*PERIGYNIUM BEAK LENGTH

210 **Absent or obsolete** (rudimentary or vestigial)
211 **0.1-0.5 mm**
212 **0.5-1 mm**
213 **1-1.5 mm**
214 **1.5-2 mm**
215 **2-3 mm**
216 **3-5 mm**
217 **>5 mm**

PERIGYNIUM BEAK CONDITION

218 **Smooth**
219 **Serrulate** (having very small marginal teeth) **or rough (at least partly)**
220 **Truncate** (cut squarely across) **at apex**
221 **Emarginate (notched) or toothed at apex**

PERIGYNIUM BASE

222 **Spongy**
223 **Round or truncate** (cut squarely across)
224 **Narrowed**
225 **Sessile** (without a stalk) **or subsessile** (<1 mm)
226 **Stalked**

*PERIGYNIUM LENGTH (INCLUDING BEAK)
227 **< 2 mm**
228 **2-4 mm**
229 **4-6 mm**
230 **6-8 mm**
231 **8-10 mm**
232 **>10 mm**

PERIGYNIUM WIDTH
233 **0.6-1.5 mm**
234 **1.5-2 mm**
235 **2-3 mm**
236 **3-4 mm**
237 **4-6 mm**
238 **>6 mm**

STYLE
239 **Straight**
240 **Flexuous** (more or less zigzag or wavy) **or bent**

*STIGMA NUMBER
241 **2**
242 **3 or 4**

FRUIT BODY
243 **Constricted**

FRUIT LENGTH
244 **0.7-2 mm**
245 **2-3 mm**
246 **>3 mm**

FRUIT WIDTH
247 **0.5-1 mm**
248 **1-2 mm**
249 **>2 mm**

ANTHER LENGTH
250 **0.3-2 mm**
251 **2-3 mm**
252 **3-4 mm**
253 **>4 mm**

Carex Key, 296 taxa.

1 Carex aboriginum
2 Carex abrupta
3 Carex abscondita
4 Carex acutiformis
5 Carex adelostoma
6 Carex aenea
7 Carex alata
8 Carex albicans
9 Carex albida
10 Carex albolutescens
11 Carex albonigra
12 Carex alma
13 Carex alopecoidea
14 Carex amphibola
15 Carex amplifolia
16 Carex angustata
17 Carex annectens
18 Carex anthoxanthea
19 Carex aperta
20 Carex aquatilis
21 Carex arcta
22 Carex arctiformis
23 Carex atherodes
24 Carex athrostachya
25 Carex atlantica
26 Carex atratiformis
27 Carex atrofusca
28 Carex atrosquama
29 Carex aurea
30 Carex baileyi
31 Carex barbarae
32 Carex barrattii
33 Carex bebbii
34 Carex bella
35 Carex bicknellii
36 Carex bicolor
37 Carex bigelowii
38 Carex bipartita
39 Carex blanda
40 Carex bolanderi
41 Carex bonanzensis
42 Carex breviligulata
43 Carex brevior
44 Carex brittoniana
45 Carex bromoides
46 Carex brunnescens
47 Carex bullata
48 Carex bushii
49 Carex buxbaumii
50 Carex californica

51 Carex canescens
52 Carex capillaris
53 Carex capitata
54 Carex caroliniana
55 Carex castanea
56 Carex cephaloidea
57 Carex cephalophora
58 Carex chapmanii
59 Carex cherokeensis
60 Carex chordorrhiza
61 Carex collinsii
62 Carex comosa
63 Carex complanata
64 Carex concinna
65 Carex conjuncta
66 Carex conoidea
67 Carex crawei
68 Carex crawfordii
69 Carex crebriflora
70 Carex crinita
71 Carex cristatella
72 Carex crus-corvi
73 Carex cryptolepis
74 Carex cumulata
75 Carex cusickii
76 Carex davisii
77 Carex debilis
78 Carex decomposita
79 Carex densa
80 Carex deweyana
81 Carex diandra
82 Carex digitalis
83 Carex disperma
84 Carex divisa
85 Carex douglasii
86 Carex eburnea
87 Carex echinata
88 Carex eleusinoides
89 Carex elliottii
90 Carex emoryi
91 Carex exilis
92 Carex exsiccata
93 Carex extensa
94 Carex festucacea
95 Carex feta
96 Carex fissa
97 Carex fissuricola
98 Carex flaccosperma
99 Carex flava
100 Carex foenea
101 Carex formosa
102 Carex frankii

103 Carex garberi
104 Carex gigantea
105 Carex glaucescens
106 Carex gmelinii
107 Carex gracillima
108 Carex granularis
109 Carex grayi
110 Carex gynocrates
111 Carex gynodynama
112 Carex hallii
113 Carex harfordii
114 Carex hassei
115 Carex haydeniana
116 Carex haydenii
117 Carex heleonastes
118 Carex hendersonii
119 Carex heteroneura
120 Carex hirtissima
121 Carex holostoma
122 Carex hoodii
123 Carex hormathodes
124 Carex hyalina
125 Carex hyalinolepis
126 Carex hystericina
127 Carex idahoa
128 Carex illota
129 Carex interior
130 Carex interrupta
131 Carex intumescens
132 Carex jonesii
133 Carex joorii
134 Carex lacustris
135 Carex laeviconica
136 Carex laeviculmis
137 Carex laevivaginata
138 Carex lanuginosa
139 Carex lapponica
140 Carex lasiocarpa
141 Carex laxa
142 Carex laxiflora
143 Carex lemmonii
144 Carex lenticularis
145 Carex leporina
146 Carex leptalea
147 Carex leptonervia
148 Carex leptopoda
149 Carex limosa
150 Carex livida
151 Carex loliacea
152 Carex lonchocarpa
153 Carex longii
154 Carex louisianica

155 Carex lugens
156 Carex lupuliformis
157 Carex lupulina
158 Carex lurida
159 Carex luzulina
160 Carex lyngbyei
161 Carex mackenziei
162 Carex macloviana
163 Carex macrocephala
164 Carex macrochaeta
165 Carex magellanica
166 Carex marina
167 Carex maritima
168 Carex meadii
169 Carex membranacea
170 Carex mendocinensis
171 Carex mertensii
172 Carex michauxiana
173 Carex michrochaeta
174 Carex microdonta
175 Carex microglochin
176 Carex microptera
177 Carex misandra
178 Carex molesta
179 Carex muskingumensis
180 Carex nardina
181 Carex nebrascensis
182 Carex nelsonii
183 Carex nervina
184 Carex neurophora
185 Carex nigra
186 Carex nigricans
187 Carex nigromarginata
188 Carex normalis
189 Carex norvegica
190 Carex nova
191 Carex novae-angliae
192 Carex nudata
193 Carex obispoensis
194 Carex obnupta
195 Carex oklahomensis
196 Carex oligosperma
197 Carex onusta
198 Carex oreocharis
199 Carex ormostachya
200 Carex oronensis
201 Carex ouachitana
202 Carex oxylepis
203 Carex pachystachya
204 Carex paleacea
205 Carex pansa
206 Carex parryana

207 Carex pauciflora
208 Carex paysonis
209 Carex pelocarpa
210 Carex phaeocephala
211 Carex pluriflora
212 Carex podocarpa
213 Carex polymorpha
214 Carex praeceptorum
215 Carex praegracilis
216 Carex prairea
217 Carex prasina
218 Carex praticola
219 Carex preslii
220 Carex projecta
221 Carex pseudocyperus
222 Carex pseudoscirpoidea
223 Carex pyrenaica
224 Carex ramenskii
225 Carex rariflora
226 Carex raynoldsii
227 Carex recta
228 Carex reniformis
229 Carex retrorsa
230 Carex richardsonii
231 Carex rostrata
232 Carex rotundata
233 Carex rupestris
234 Carex salina
235 Carex sartwellii
236 Carex saxatilis
237 Carex scabrata
238 Carex schottii
239 Carex schweinitzii
240 Carex scirpoidea
241 Carex scoparia
242 Carex scopulorum
243 Carex senta
244 Carex seorsa
245 Carex serratodens
246 Carex sheldonii
247 Carex shortiana
248 Carex simulata
249 Carex sparganioides
250 Carex specifica
251 Carex spectabilis
252 Carex spissa
253 Carex sprengelii
254 Carex squarrosa
255 Carex sterilis
256 Carex stipata
257 Carex straminea
258 Carex striata

259 Carex stricta
260 Carex styloflexa
261 Carex stylosa
262 Carex subbracteata
263 Carex suberecta
264 Carex subnigricans
265 Carex subspathacea
266 Carex swanii
267 Carex sychnocephala
268 Carex tenera
269 Carex tenuiflora
270 Carex tetanica
271 Carex thurberi
272 Carex tincta
273 Carex torreyi
274 Carex torta
275 Carex triangularis
276 Carex tribuloides
277 Carex trichocarpa
278 Carex trisperma
279 Carex tuckermanii
280 Carex turgescens
281 Carex typhina
282 Carex unilateralis
283 Carex ursina
284 Carex utriculata
285 Carex vaginata
286 Carex venusta
287 Carex vernacula
288 Carex verrucosa
289 Carex vesicaria
290 Carex vicaria
291 Carex viridula
292 Carex vulpinoidea
293 Carex wiegandii
294 Carex willdenowii
295 Carex williamsii
296 Carex woodii

Juncus
Key

259 Carex stricta
260 Carex styloflexa
261 Carex stylosa
262 Carex subbracteata
263 Carex suberecta
264 Carex subnigricans
265 Carex subspathacea
266 Carex swanii
267 Carex sychnocephala
268 Carex tenera
269 Carex tenuiflora
270 Carex tetanica
271 Carex thurberi
272 Carex tincta
273 Carex torreyi
274 Carex torta
275 Carex triangularis
276 Carex tribuloides
277 Carex trichocarpa
278 Carex trisperma
279 Carex tuckermanii
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289 Carex vesicaria
290 Carex vicaria
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292 Carex vulpinoidea
293 Carex wiegandii
294 Carex willdenowii
295 Carex williamsii
296 Carex woodii

JUNCUS
Key

JUNCUS

General	Stem	Leaf	Flower/ Inflorescence	Fruit
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Duration/ Habit 71–73 98	Number/ Condition 87–98	Position 104–110	Head 197–211	Seed Size 312–315 321–323
Size 79–86 99–103		Number 111–114	Size 157 167–176	Seed Surface 316–317
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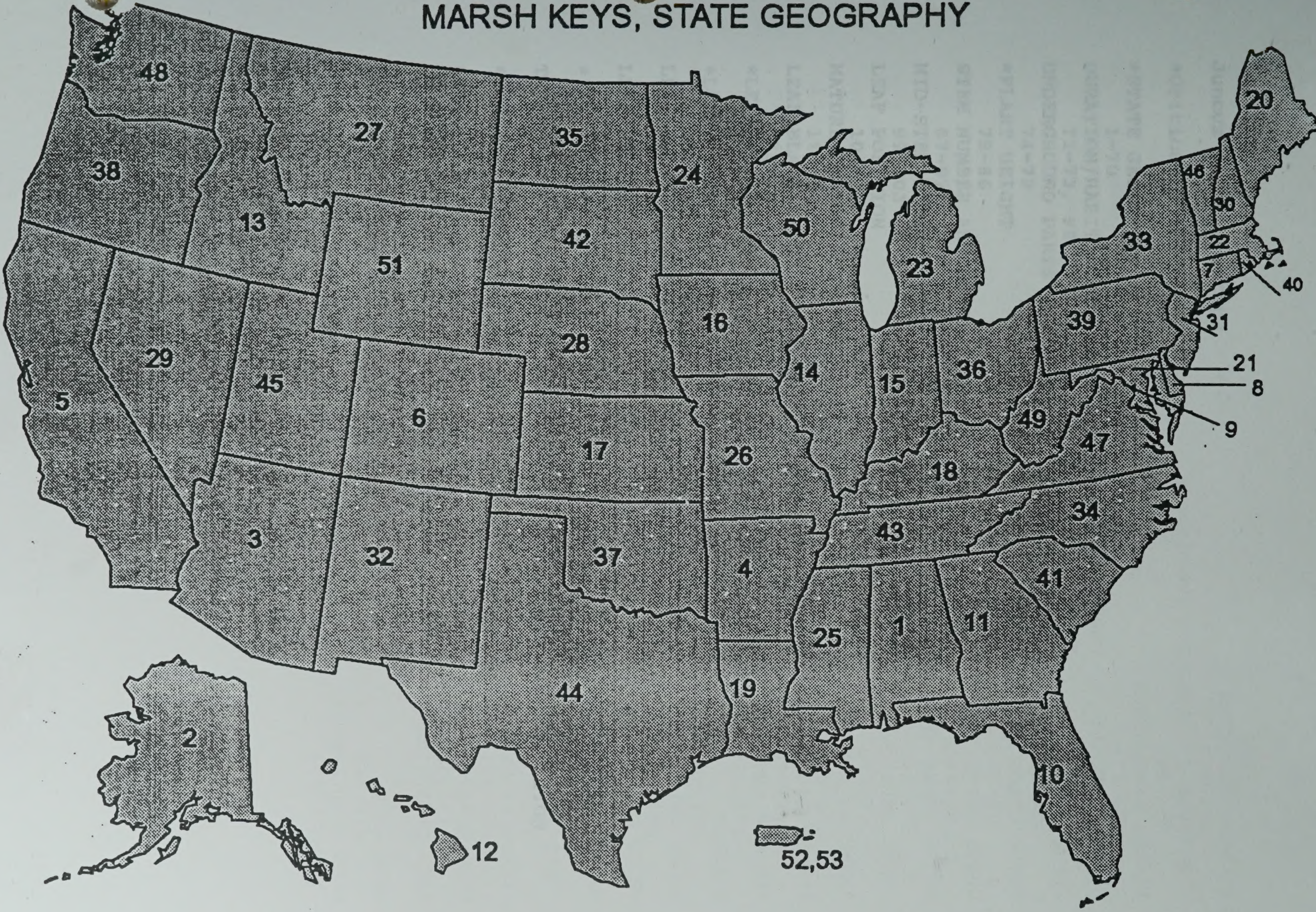
MARSH KEYS, STATE GEOGRAPHY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Juncus Key Characters

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316-317
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Juncus Key, 323 characters.

*Critical Characters

*State Geography
1 Alabama
2 Alaska
3 Arizona
4 Arkansas
5 California
6 Colorado
7 Connecticut
8 Delaware
9 District of Columbia
10 Florida
11 Georgia
12 Hawaii
13 Idaho
14 Illinois
15 Indiana
16 Iowa
17 Kansas
18 Kentucky
19 Louisiana
20 Maine
21 Maryland
22 Massachusetts
23 Michigan
24 Minnesota
25 Mississippi
26 Missouri
27 Montana
28 Nebraska
29 Nevada
30 New Hampshire
31 New Jersey
32 New Mexico
33 New York
34 North Carolina
35 North Dakota
36 Ohio
37 Oklahoma
38 Oregon
39 Pennsylvania
40 Rhode Island
41 South Carolina
42 South Dakota
43 Tennessee
44 Texas
45 Utah
46 Vermont
47 Virginia

48 **Washington**
49 **West Virginia**
50 **Wisconsin**
51 **Wyoming**
52 **Puerto Rico**
53 **Virgin Islands**
54 **Alberta**
55 **British Columbia**
56 **Franklin**
57 **Keewatin**
58 **Labrador**
59 **MacKenzie**
60 **Manitoba**
61 **New Brunswick**
62 **Newfoundland**
63 **Nova Scotia**
64 **Ontario**
65 **Prince Edward Island**
66 **Quebec**
67 **Saskatchewan**
68 **Yukon Territory**
69 **Greenland (Denmark)**
70 **St. Pierre and Miquelon Islands (France)**

DURATION/HABIT
71 **Annual (living for one year)**
72 **Perennial (living several to many seasons)**
73 **Mat-forming or colonial**
98 **Stem floating**

UNDERGROUND PARTS (skip if an annual)
74 **Rhizome >10 cm long (a creeping, underground stem with roots often produced from nodes)**
75 **Rhizome <10 cm long or absent**
76 **Rhizome knotty**
77 **Stolon present (a shoot that bends to the ground and takes root or a horizontal stem at or below the surface of the ground that gives rise to a new plant at the tip)**
78 **Corm, tuber or bulb present (corm: an enlarged solid fleshy base of a stem with scales; tuber: a thick storage stem with an enlarged fleshy base, usually upright; bulb: an underground leaf bud with thickened scales)**

*PLANT HEIGHT
79 **<5 cm**
80 **5-10 cm**
81 **10-20 cm**
82 **20-30 cm**
83 **30-50 cm**
84 **50-70 cm**
85 **70-100 cm**
86 **>100 cm**

STEM NUMBER AND CONDITION

87 **Solitary**
88 **Caespitose (2+)**
89 **Branched**
90 **Unbranched**
91 **Decumbent** (reclining with tips ascending)
92 **Ascending** (rising obliquely or curving upward)
93 **Erect** (upright)
94 **Compressed** (flattened laterally)
95 **Round**
96 **Longitudinally Ribbed**
97 **Surface wrinkled or twisted**
98 **Floating**

MID-STEM WIDTH

99 **<0.5 mm**
100 **0.5-1 mm**
101 **1-2 mm**
102 **2-5 mm**
103 **>5 mm**

LEAF POSITION

104 **Reduced\absent**
105 **Basal**
106 **Basal\cauline**
107 **Cauline** (on stem)
108 **Equitant** (two-ranked and flattened with edges toward and away from axis)
109 **Cauline leaves below mid-stem**
110 **Cauline leaves above mid-stem**

MATURE LEAVES PER STEM

111 **1-2**
112 **3-5**
113 **6-10**
114 **>11**

LEAF BLADE SHAPE, VESTITURE, AND COLOR

115 **Flat**
116 **Channeled** (deeply grooved longitudinally, like a gutter)
117 **Carinate or folded** (keeled, with a sharp longitudinal ridge)
118 **Terete** (round)
119 **Revolute or involute** (revolute: margin rolled under toward lower side of leaf; involute: margin rolled toward upper side of leaf)
120 **Glabrous** (without hairs)
121 **Ciliate or pilose at base** (ciliate: fringe of fine marginal hairs; pilose: with long, soft, straight hairs)
122 **Conspicuously septate** (partitioned by walls)
123 **Obscurely or incompletely septate**
124 **Non-septate**
125 **Glaucous or bluish-green** (covered with a whitened bloom or smooth waxy coating)
126 **Dark green**
127 **Yellowish-green**
128 **Red, brown or pink**
129 **Apex pungent** (with a sharp, rigid point)

*LEAF BLADE LENGTH

130 **<5 cm**
131 **5-10 cm**
132 **10-20 cm**
133 **20-30 cm**
134 **30-50 cm**
135 **>50 cm**

*LEAF BLADE WIDTH

136 **<0.5 mm**
137 **0.5-1 mm**
138 **1-2 mm**
139 **2-5 mm**
140 **5-10 mm**
141 **10-15 mm**
142 **>15 mm**

LEAF SHEATH CONDITION AND COLOR (leaf sheath: tubular part of leaf which envelopes the stem)

143 **Closed** (fused for a portion of their length)
144 **Open**
145 **Yellow or green**
146 **Orange**
147 **Red or brown**
148 **Purple**

LEAF SHEATH AURICLE (auricle: ear-shaped appendage situated at top of leaf sheath)
149 Absent
150 <1 mm long
151 1-3 mm long
152 3-6 mm long
153 White
154 Yellow
155 Brown

*INFLORESCENCE POSITION
158 Terminal
159 Terminal and axillary
160 Appearing lateral

TERMINAL INFLORESCENCE INVOLUCRAL BRACT NUMBER AND CONDITION (involucral bract: a more or less distinct whorl of reduced leaves, branchlets, or bracts subtending a flower or inflorescence)
161 0
162 1+
163 Apex pungent (with a sharp, rigid point)
164 Lowest involucral bract < inflorescence
165 Lowest involucral bract = inflorescence
166 Lowest involucral bract > inflorescence

*TERMINAL INFLORESCENCE LENGTH
167 <2 cm
168 2-5 cm
169 5-10 cm
170 10-20 cm
171 >20 cm

*TERMINAL INFLORESCENCE WIDTH
172 <2 cm
173 2-5 cm
174 5-10 cm
175 10-15 cm
176 >15 cm

INFLORESCENCE TYPE AND CONDITION

156 **Bulblets present in the inflorescence** (bulbet: a small bulb)
157 **Inflorescence > stem**
177 **1-many solitary flowers**
178 **Head or glomerule** (dense sessile aggregate of flowers)
179 **Raceme\spike** (raceme: an unbranched elongate inflorescence with pedicelled flowers; spike: an unbranched elongate inflorescence with sessile flowers)
180 **Umbel\cyme\corymb** (umbel: a flat or convex flower cluster in which the pedicels arise from a common point, like rays of an umbrella; cyme: a determinate inflorescence of various shapes or degrees of branching, but the oldest flower is always on the end of the branch; corymb: a flat-topped or convex raceme with lower pedicels elongated and rachis shortened)
181 **Panicle** (a branched elongate inflorescence with two or more pedicelled flowers per branch)
182 **Diffuse\open**
183 **Lax** (drooping) **or loose**
184 **Congested** (dense)

PRIMARY RAY (of inflorescence) CONDITION

185 **Unbranched**
186 **Branched once**
187 **Repeatedly branched**
188 **Ascending** (rising obliquely or curving upward)
189 **Horizontal\reflexed** (abruptly bent or turned downward or backward)

FLOWER NUMBER PER STEM (skip if flowers clustered into heads)

190 **1-5**
191 **6-10**
192 **11-20**
193 **21-40**
194 **>40**
195 **Primary peduncle 1-flowered**
196 **Primary peduncle 2+ flowered**

HEAD/GLOMERULE CONDITION (head: a dense cluster of sessile or nearly sessile flowers)

197 **Cylindrical\turbinate** (top-shaped or conical with broad end uppermost)
198 **Ovoid or campanulate** (ovoid: broadly elliptical, a flattened circle usually more than twice as long as broad; campanulate: bell-shaped)
199 **Sessile\sub-sessile** (without a stalk or with a stalk <1 mm)
200 **Distinctly peduncled** (stalked)

*HEAD/GLOMERULE PER STEM
201 **1**
202 **2-5**
203 **6-10**
204 **11-20**
205 **21-30**
206 **31-50**
207 **51-100**
208 **>100**

HEAD/GLOMERULE WIDTH
209 **2-5 mm**
210 **5-10 mm**
211 **>10 mm**

FLOWERS PER HEAD/GLOMERULE
212 **2-5**
213 **6-10**
214 **11-15**
215 **16-20**
216 **21-30**
217 **31-50**
218 **51-100**
219 **>100**

FLOWER CONDITION
220 **Sessile** (not stalked)
221 **Pedicellate** (secondary stalk to a single flower of an inflorescence)
222 **Ebracteolate (lacking prophylls)** (lacking bracts)
223 **With 2 bracteoles subtending the tepals** (bracteoles: secondary bracts on pedicels of flowers)

BRACTEOLE (= PROPHYLL) CONDITION
224 **Apex obtuse-acute** (obtuse: margins form a terminal angle >90 degrees; acute: margins form a terminal angle of 45-90 degrees)
225 **Apex acuminate or aristate** (acuminate: margins form a terminal angle of <45 degrees; aristate: awn or bristle-tipped)
226 **Apex and margin lacerate** (appearing irregularly torn or cleft)
227 **Unequal**

FLOWER ARRANGEMENT
228 **1 per node**
229 **2 or 3 per node**
230 **Secund on inflorescence axis** (comb-like or directed to one side only)

TEPAL (= PERIANTH) CHARACTER (tepal: sepals and petals of similar form and not readily differentiated)

231 **Outer and inner series =**
232 **Outer series >**
233 **Inner series >**

*LONGEST TEPAL LENGTH

234 **<2 mm**
235 **2-3 mm**
236 **3-5 mm**
237 **>5 mm**

TEPAL COLOR AND CONDITION

238 **Red, brown, or pink**
239 **Green**
240 **Yellow**
241 **White**
242 **Black or purple**
243 **Red- or brown-striped**
244 **Green midrib**
245 **Non-green midrib**
246 **Hyaline or scarious margined** (hyaline: colorless, transparent, or translucent; scarious: thin and dry, appearing shriveled)
247 **Glabrous** (without hairs)
248 **Hairy, ciliate or papillate** (ciliate: fringe of fine marginal hairs; papillate: bearing minute, nipple-shaped projections)
249 **Membranous** (thin, soft, pliable)
250 **Coriaceous** (thick and leathery, eg. Rhododendron)

OUTER TEPAL SHAPE

251 **Linear, oblong, or subulate** (linear: long and narrow, of uniform width; oblong: much longer than broad with nearly parallel sides: subulate: awl-shaped)
252 **Ovate or lanceolate** (ovate: egg-shaped, broadest below middle; lanceolate: broadened at base and tapering toward apex)
253 **Elliptic or rotund** (elliptic: broadest point midway between ends and width about one-half length; rotund: round)
254 **Obovate or oblanceolate** (obovate: inverse of ovate, with broadest half above middle and narrower end toward base; oblanceolate: inverse of lanceolate with broadest half above middle and tapering toward base)
255 **Keeled** (a prominent longitudinal ridge, like the keel of a boat)

OUTER TEPAL APEX

256 **Truncate or retuse** (truncate: cut squarely across; retuse: with a shallow rounded notch)
257 **Obtuse\round** (obtuse: margins form a terminal angle >90 degrees)
258 **Mucronate** (with a short, small, abrupt tip)
259 **Acute** (margins form a terminal angle of 45-90 degrees)
260 **Acuminate\subulate** (acuminate: margins form a terminal angle of <45 degrees; subulate: awl-shaped)
261 **Cuspidate\aristate** (cuspidate: with a short, rigid point; aristate: awn or bristle tipped)
262 **Incurved** (curved toward axis or attachment)
263 **Ascending\spreading** (ascending: rising obliquely or curving upward)
264 **Recurved** (curved outward, downward, or backward)

INNER TEPAL APEX

265 **Truncate\retuse** (truncate: cut squarely across; retuse: shallow notch at a rounded apex)
266 **Obtuse\round** (obtuse: margins form a terminal angle >90 degrees)
267 **Mucronate** (with a short, small, abrupt tip)
268 **Acute** (margins form a terminal angle of 45-90 degrees)
269 **Acuminate\subulate** (acuminate: margins form a terminal angle of <45 degrees; subulate: awl-shaped)
270 **Cuspidate\aristate** (cuspidate: with a sharp, firm point; aristate: awn or bristle tipped)

*ANTHERS PER FLOWER (anther: pollen-bearing part of stamen)

271 **2-3**
272 **6**

ANTHER COLOR

273 **Red\brown**
274 **Yellow**
275 **Purple**
276 **White**

*ANTHER LENGTH AND CONDITION

277 **<0.5 mm**
278 **0.5-1 mm**
279 **1-2 mm**
280 **2-3 mm**
281 **>3 mm**
282 **Anthers < filaments** (thread-like portion of stamen that supports the anther)
283 **Anthers = filaments**
284 **Anthers > filaments**
285 **Anthers included in flower at anthesis**
286 **Anthers exserted from flower at anthesis** (exserted: projecting beyond tepals)

STIGMA
287 **Included in flower at anthesis**
288 **Exserted from flower at anthesis**

FRUIT COLOR
289 **Green**
290 **Yellow**
291 **Red\brown**
292 **Black\purple**

FRUIT SHAPE
293 **Cylindrical\oblong** (much longer than broad with nearly parallel sides)
294 **Ovate\lanceolate\pyramidal** (broadest at base and tapering to apex)
295 **Ovoid\elliptic** (broadest at middle)
296 **Obovate\oblanceolate** (broadest above middle)

FRUIT APEX
297 **Truncate\retuse** (truncate: cut squarely across; retuse: a rounded apex with a shallow notch)
298 **Obtuse\round** (obtuse: margins form a terminal angle >90 degrees)
299 **Acute** (margins form a terminal angle of 45-90 degrees)
300 **Mucronate\apiculate** (mucronate: with a short, small, abrupt tip; apiculate: terminated abruptly in a little point)
301 **Acuminate\subulate** (acuminate: margins form a terminal angle of <45 degrees; subulate: awl-shaped)
302 **Beaked** (with a hard, firm point or projection)

FRUIT LENGTH
303 **<3 mm**
304 **3-5 mm**
305 **>5 mm**
306 **< tepals**
307 **= tepals**
308 **> tepals**

*SEEDS PER FRUIT
309 **3**
310 **5-10**
311 **>10**

SEED LENGTH (including tails)
312 **<0.5 mm**
313 **0.5-1 mm**
314 **1-2 mm**
315 **>2 mm**

SEED CONDITION
316 **Conspicuously ridged\reticulate** (in the form of a network)
317 **Smooth or faintly ridged\reticulate**

SEED APEX
318 **Apiculate at 1 or 2 ends** (apiculate: terminated abruptly in a little point)
319 **Base caruncled** (an excrescence or outgrowth at or near the hilum [scar at point of attachment of seed])
320 **Tailed at 2 ends**

SEED TAIL LENGTH (relative to seed body)
321 **< seed body**
322 **= seed body**
323 **> seed body**

Juncus key, 104 taxa.

1 Juncus abortivus
2 Juncus acuminatus
3 Juncus acutus
4 Juncus albescens
5 Juncus alpinoarticulatus
6 Juncus arcticus
7 Juncus articulatus
8 Juncus balticus
9 Juncus biflorus
10 Juncus biglumis
11 Juncus bolanderi
12 Juncus brachycarpus
13 Juncus brachycephalus
14 Juncus brevicaudatus
15 Juncus bryoides
16 Juncus bufonius
17 Juncus bulbosus
18 Juncus caesariensis
19 Juncus canadensis
20 Juncus capitatus
21 Juncus castaneus
22 Juncus compressus
23 Juncus confusus
24 Juncus cooperi
25 Juncus coriaceus
26 Juncus covillei
27 Juncus debilis
28 Juncus dichotomus
29 Juncus diffusissimus
30 Juncus drummondii
31 Juncus dubius
32 Juncus effusus
33 Juncus elliottii
34 Juncus ensifolius
35 Juncus falcatus
36 Juncus filiformis
37 Juncus filipendulus
38 Juncus gerardii
39 Juncus greenei
40 Juncus gymnocarpus
41 Juncus hallii
42 Juncus hemiendytus
43 Juncus inflexus
44 Juncus interior
45 Juncus kelloggii
46 Juncus lesueurii
47 Juncus longii
48 Juncus longistylis
49 Juncus macrandrus
50 Juncus macrophyllus
51 Juncus marginatus
52 Juncus megacephalus
53 Juncus mertensianus
54 Juncus mexicanus
55 Juncus militaris
56 Juncus nevadensis
57 Juncus nodatus
58 Juncus nodosus
59 Juncus orthophyllus
60 Juncus oxymeris
61 Juncus parryi
62 Juncus patens
63 Juncus pelocarpus
64 Juncus phaeocephalus
65 Juncus polycephalus
66 Juncus regelii
67 Juncus repens
68 Juncus roemerianus
69 Juncus rugulosus
70 Juncus saximontanus
71 Juncus scirpoides
72 Juncus secundus
73 Juncus squarrosus
74 Juncus stygius
75 Juncus subcaudatus
76 Juncus subnodulosus
77 Juncus subtilis
78 Juncus supiniformis
79 Juncus tenuis
80 Juncus texanus
81 Juncus textilis
82 Juncus torreyi
83 Juncus tracyi
84 Juncus triformis
85 Juncus triglumis
86 Juncus trigonocarpus
87 Juncus tweedyi
88 Juncus uncialis
89 Juncus validus
90 Juncus vaseyi
91 Juncus xiphioides
92 Luzula acuminata
93 Luzula arctica
94 Luzula arcuata
95 Luzula bulbosa
96 Luzula confusa
97 Luzula congesta
98 Luzula echinata
99 Luzula multiflora
100 Luzula parviflora
101 Luzula rufescens

102 Luzula spicata
103 Luzula subcapitata
104 Luzula wahlenbergii

Fapp
Vet

Juncus key, 104 taxa.

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28 Juncus dichotomus
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96 Luzula confusa
97 Luzula congesta
98 Luzula echinata
99 Luzula multiflora
100 Luzula parviflora
101 Luzula rufescens

FERN
KEY

FERN

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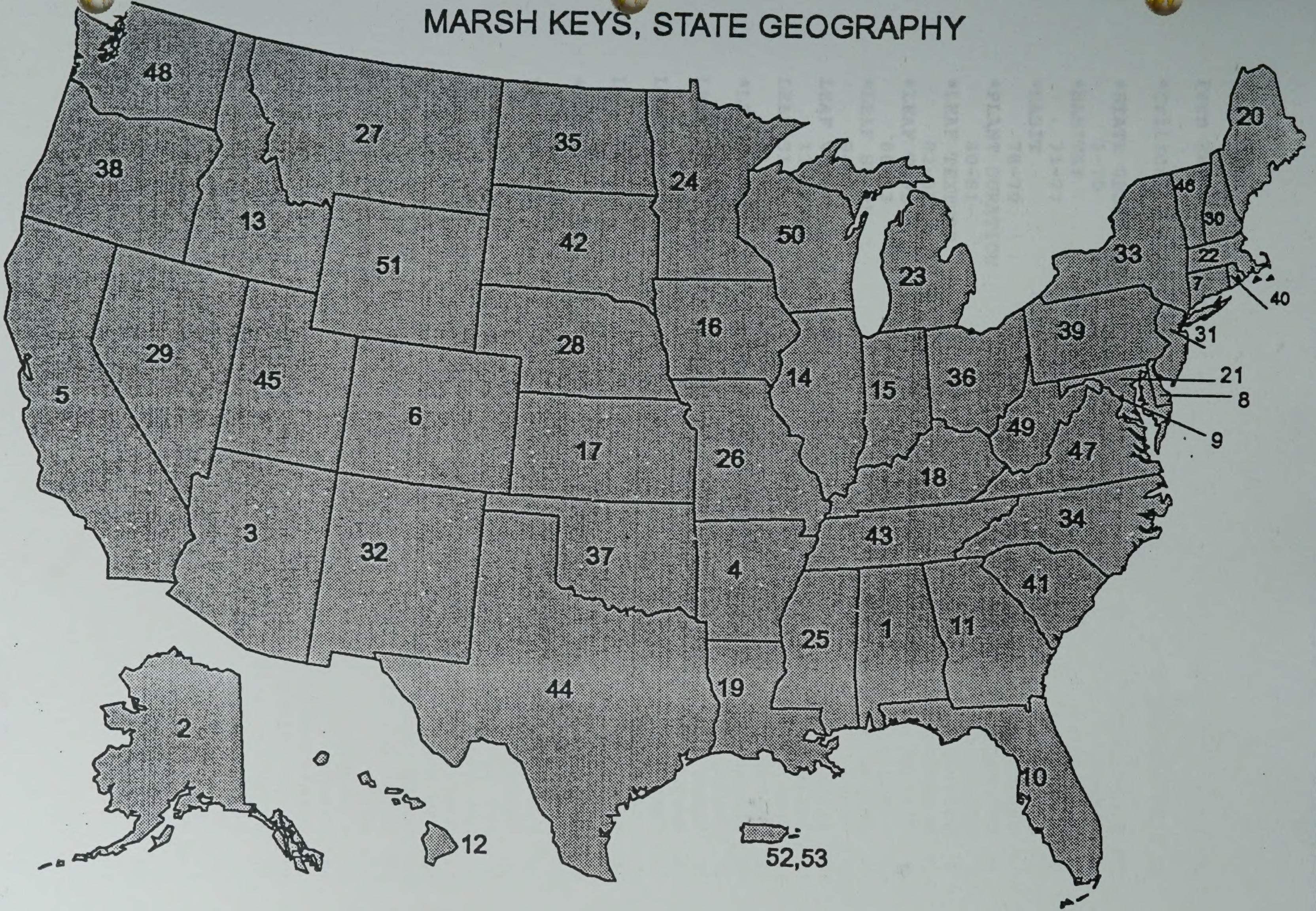
MARSH KEYS, STATE GEOGRAPHY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Fern Key Characters

*Critical Characters

*STATE GEOGRAPHY
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*PLANT DURATION
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*LEAF TEXTURE
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Fern Key, 205 characters.

*Critical Characters

*STATE GEOGRAPHY
1 **Alabama**
2 **Alaska**
3 **Arizona**
4 **Arkansas**
5 **California**
6 **Colorado**
7 **Connecticut**
8 **Delaware**
9 **District of Columbia**
10 **Florida**
11 **Georgia**
12 **Hawaii**
13 **Idaho**
14 **Illinois**
15 **Indiana**
16 **Iowa**
17 **Kansas**
18 **Kentucky**
19 **Louisiana**
20 **Maine**
21 **Maryland**
22 **Massachusetts**
23 **Michigan**
24 **Minnesota**
25 **Mississippi**
26 **Missouri**
27 **Montana**
28 **Nebraska**
29 **Nevada**
30 **New Hampshire**
31 **New Jersey**
32 **New Mexico**
33 **New York**
34 **North Carolina**
35 **North Dakota**
36 **Ohio**
37 **Oklahoma**
38 **Oregon**
39 **Pennsylvania**
40 **Rhode Island**
41 **South Carolina**
42 **South Dakota**
43 **Tennessee**
44 **Texas**
45 **Utah**
46 **Vermont**
47 **Virginia**

48 Washington
49 West Virginia
50 Wisconsin
51 Wyoming
52 Puerto Rico
53 Virgin Islands
54 Alberta
55 British Columbia
56 Franklin
57 Keewatin
58 Labrador
59 MacKenzie
60 Manitoba
61 New Brunswick
62 Newfoundland
63 Nova Scotia
64 Ontario
65 Prince Edward Island
66 Quebec
67 Saskatchewan
68 Yukon Territory
69 Greenland (Denmark)
70 St. Pierre and Miquelon Islands (France)

*HABITAT
71 **Amphibious in fresh water**
72 **Amphibious in saline water**
73 **Aquatic floating**
74 **Aquatic but rooted**
75 **Terrestrial**
76 **Epiphytic** (growing on vegetation)
77 **Epipetric** (growing on rocks)

*HABIT
78 **Vine-like**
79 **Grass-like**

*PLANT DURATION
80 **Leafy fronds evergreen** (persistent leaves remain green during the dormant or winter season)
81 **Leafy fronds deciduous** (leaves fall at end of one season of growth)

*LEAF TEXTURE
82 **Leafy fronds coriaceous** (leathery, eg. Rhododendron)
83 **Leafy fronds membranous** (flimsy, thin, or pliable)
84 **Leafy fronds translucent, delicate, filmy (1 cell thick)**
85 **Leafy fronds succulent and/or prostrate**

*LEAF TYPE
86 **Fertile and sterile blades similar**
87 **Fertile and sterile blades different, common stipe**
88 **Fertile and sterile blade insertion of common stipe > middle**
89 **Fertile and sterile blade insertion of common stipe at middle**
90 **Fertile and sterile blade insertion of common stipe < middle**
91 **Fertile and sterile blades different, separate stipes**
92 **Fertile and sterile portion very different, common blade**
93 **Fertile and sterile portion slightly different, common blade**

*LEAF SHAPE

94 **Sterile frond not pinnate**
95 **Sterile frond once pinnate** (with leaflets arranged oppositely or alternately along rachis)
96 **Sterile frond twice pinnate** (with 2 orders of leaflets, each pinnately compound)
97 **Sterile frond 3 times pinnate** (with 3 orders of leaflets, each pinnately compound)
98 **Sterile frond 4 times pinnate**
99 **Sterile frond not pinnatifid**
100 **Sterile frond once pinnatifid** (pinnately cleft into narrow lobes not reaching to midrib)
101 **Sterile frond twice pinnatifid**
102 **Sterile frond 3 times pinnatifid**
103 **Sterile frond 4 times pinnatifid**
104 **Sterile frond simple**
105 **Fertile frond not pinnate**
106 **Fertile frond once pinnate**
107 **Fertile frond twice pinnate**
108 **Fertile frond 3 times pinnate**
109 **Fertile frond 4 times pinnate**
110 **Fertile frond 5 times pinnate**
111 **Fertile frond not pinnatifid**
112 **Fertile frond once pinnatifid**
113 **Fertile frond twice pinnatifid**
114 **Fertile frond 3 times pinnatifid**
115 **Fertile frond 4 times pinnatifid**
116 **Fertile frond 5 times pinnatifid**
117 **Fertile frond simple**
118 **Leafy frond ternate** (divided into 3 equal or sub-equal parts)
119 **Leafy frond palmate** (hand-shaped with the fingers spread)
120 **Leafy frond pedate** (palmately divided with lateral segments 2-cleft)
121 **Leafy frond lunate** (shaped like a small crescent or half-moon)
122 **Leafy frond tripartite**
123 **Leafy frond fan-shaped**
124 **Leafy frond basally tapered to the extreme** (narrowly vase-shaped)
125 **Leafy frond bent backward slightly**
126 **Leafy frond narrowing abruptly at apex (Dryopteris)**
127 **Leafy frond narrowing gradually at apex (Dryopteris)**
128 **Leafy frond triangular or oval-shaped (Dryopteris)**
129 **Pinnae boot- or ear-shaped** (pinna: a stalked or sessile, primary division of a compound leaf that is narrowed at base)
130 **Ultimate leaf segments long-attenuate**

LEAF VENATION

131 **Leafy frond veins thickening toward margin (Trichomanes)**
132 **Leafy frond veins most slender toward margin (Trichomanes)**

LEAF SIZE

133 **Leafy frond length <2 cm**
134 **Leafy frond length 2-10 cm**
135 **Leafy frond length 10-30 cm**
136 **Leafy frond length 30-100 cm**
137 **Leafy frond length >100 cm**
138 **Leafy frond width <2.5 cm**
139 **Leafy frond width 2.5-6 cm**
140 **Leafy frond width 6-20 cm**
141 **Leafy frond width 20-30 cm**
142 **Leafy frond width >30 cm**
143 **Fertile frond length > sterile frond**
144 **Sterile frond length > fertile frond**
145 **Pinna width > length**
146 **Pinna length > width**
147 **Lowest pinnae < middle pinnae**
148 **Lowest pinnae = middle pinnae**
149 **Lowest pinnae > middle pinnae**
150 **Basal pinnule of basal pinnae < previous pinnule**
151 **Basal pinnule of basal pinnae > previous pinnule**

*LEAF MARGIN

152 **Simple blade mucronate apically** (mucronate: with a short, small, abrupt tip)
153 **Sterile blade not toothed or lobed**
154 **Leafy frond margin entire** (without teeth)
155 **Leafy frond margin ciliate** (fringed with fine hairs)
156 **Leafy frond margin revolute** (margin rolled under toward lower side of leaf)
157 **Leafy frond margin toothed**
158 **Leafy frond margin teeth round**
159 **Leafy frond margin teeth pointed**
160 **Leafy frond margin bristle-tipped toothed**
161 **Leafy frond margin with scales**

LEAF BLADE VESTITURE/COLOR

162 **Sterile pinnae glabrous** (without hairs)
163 **Sterile pinnae stalked-glandular-hairy**
164 **Sterile pinnae sessile-glandular-dotted**
165 **Sterile pinnae stellate- or forked-hairy**
166 **Sterile pinnae pilose (long-hairy or long-scaly) beneath**
167 **Sterile pinnae puberulent (short-hairy) beneath**
168 **Sterile pinnae stalk woolly-tufted at base**
169 **Sterile pinnae hairs primarily present on veins**
170 **Sterile pinnae sulfur-colored beneath**
171 **Upper pinnae bulbiferous**

LEAF POSITION

172 **Lowest pinnae opposite**
173 **Lowest pinnae alternate**
174 **Pinnae overlapping (i.e., crowded)**

LEAF PETIOLE
175 **Lowest pinnae sessile** (not stalked)
176 **Lowest pinnae stalked**

*FERTILE PINNAE POSITION
177 **Mature fertile pinnae on top half of frond only**
178 **Mature fertile pinnae on the middle of frond only**
179 **Mature fertile pinnae throughout frond**
180 **Mature fertile pinnae lacking expanded blade**

*FRUIT POSITION
181 **Indusium present**
182 **Indusium cup, funnel, or tube-shaped**
183 **Sori marginal** (sori: clusters of sporangia)
184 **Sori submarginal**

*FRUIT SHAPE
185 **Sori arranged in a chain-like row**
186 **Sori shape round**
187 **Sori shape linear, J- or C-shaped**
188 **Sori shape reniform** (kidney-shaped)
189 **Sporangia not in sori and covering the entire ventral leaf surface**

*STEM VESTITURE
190 **Rachis glabrous** (without hairs)
191 **Rachis with hairs above middle or throughout**
192 **Rachis with scales above middle or throughout**

*STEM CONDITION
193 **Rachis winged** (with flattened membrane bordering each side)
194 **Rachis spiny/prickly**
195 **Rachis/stipe inflated**
196 **Rachis dichotomously branched**
197 **Rachis black or deep purple**
198 **Stipe length equal to blade length (Dryopteris)**
199 **Stem base bulbiferous**

UNDERGROUND PARTS
200 **Rhizome with conspicuous orange stripe**
201 **Rhizome erect or ascending**
202 **Rhizome short-creeping**
203 **Rhizome long-creeping**

PLANT FRAGRANCE
204 **Leaves fragrant when crushed**
205 **Rhizome with fetid odor**

Fern Key, 102 taxa.

1	Acrostichum aureum
2	Acrostichum danaeifolium
84	Actinostachys pennula
6	Adiantum tricholepis
5	Adiantum tenerum
3	Adiantum capillus-veneris
4	Adiantum pedatum
12	Asplenium platyneuron
13	Asplenium trichomanes-ramosum
25	Athyrium americanum
26	Athyrium filix-femina
15	Blechnum spicant
14	Blechnum serrulatum
66	Botrychium pinnatum
65	Botrychium multifidum
60	Botrychium biternatum
61	Botrychium dissectum
63	Botrychium lunaria
67	Botrychium simplex
64	Botrychium matricariifolium
62	Botrychium lanceolatum
68	Botrychium virginianum
81	Campyloneurum angustifolium
82	Campyloneurum latum
78	Ceratopteris pteridoides
80	Ceratopteris thalictroides
79	Ceratopteris richardii
69	Cheiroglossa palmata
7	Cryptogramma stelleri
27	Ctenitis submarginalis
28	Cystopteris bulbifera
29	Cystopteris fragilis
30	Cystopteris montana
31	Deparia acrostichoides
50	Dicranopteris flexuosa
32	Diplazium pycnocarpon
35	Dryopteris clintoniana
34	Dryopteris celsa
33	Dryopteris carthusiana
40	Dryopteris ludoviciana
41	Dryopteris marginalis
37	Dryopteris expansa
36	Dryopteris cristata
39	Dryopteris intermedia
38	Dryopteris goldiana
43	Gymnocarpium robertianum
42	Gymnocarpium dryopteris
51	Hymenophyllum wrightii
22	Hypolepis repens
44	Lomariopsis kunzeana

85	Lygodium japonicum
86	Lygodium palmatum
88	Macrothelypteris torresiana
45	Matteuccia struthiopteris
83	Microsorum scolopendria
21	Nephrolepis exaltata
20	Nephrolepis biserrata
46	Onoclea sensibilis
74	Ophioglossum vulgatum
70	Ophioglossum crotalophoroides
73	Ophioglossum petiolatum
72	Ophioglossum nudicaule
71	Ophioglossum engelmannii
76	Osmunda claytoniana
75	Osmunda cinnamomea
77	Osmunda regalis
89	Phegopteris hexagonoptera
59	Pilularia americana
8	Pityrogramma trifoliata
47	Polystichum acrostichoides
48	Polystichum lonchitis
23	Pteridium aquilinum
11	Pteris tripartita
9	Pteris ensiformis
10	Pteris grandifolia
87	Schizaea pusilla
24	Sphenomeris clavata
49	Tectaria incisa
95	Thelypteris noveboracensis
96	Thelypteris ovata
94	Thelypteris nevadensis
93	Thelypteris kunthii
92	Thelypteris interrupta
97	Thelypteris palustris
98	Thelypteris reptans
102	Thelypteris simulata
101	Thelypteris serrata
100	Thelypteris sclerophylla
99	Thelypteris resinifera
91	Thelypteris hispidula
90	Thelypteris dentata
56	Trichomanes membranaceum
57	Trichomanes petersii
58	Trichomanes punctatum
55	Trichomanes lineolatum
54	Trichomanes krausii
52	Trichomanes boschianum
53	Trichomanes holopterum
17	Woodwardia fimbriata
18	Woodwardia radicans
16	Woodwardia areolata
19	Woodwardia virginica

Fern Key, 102 taxa

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2 Acrostichum danaeifolium
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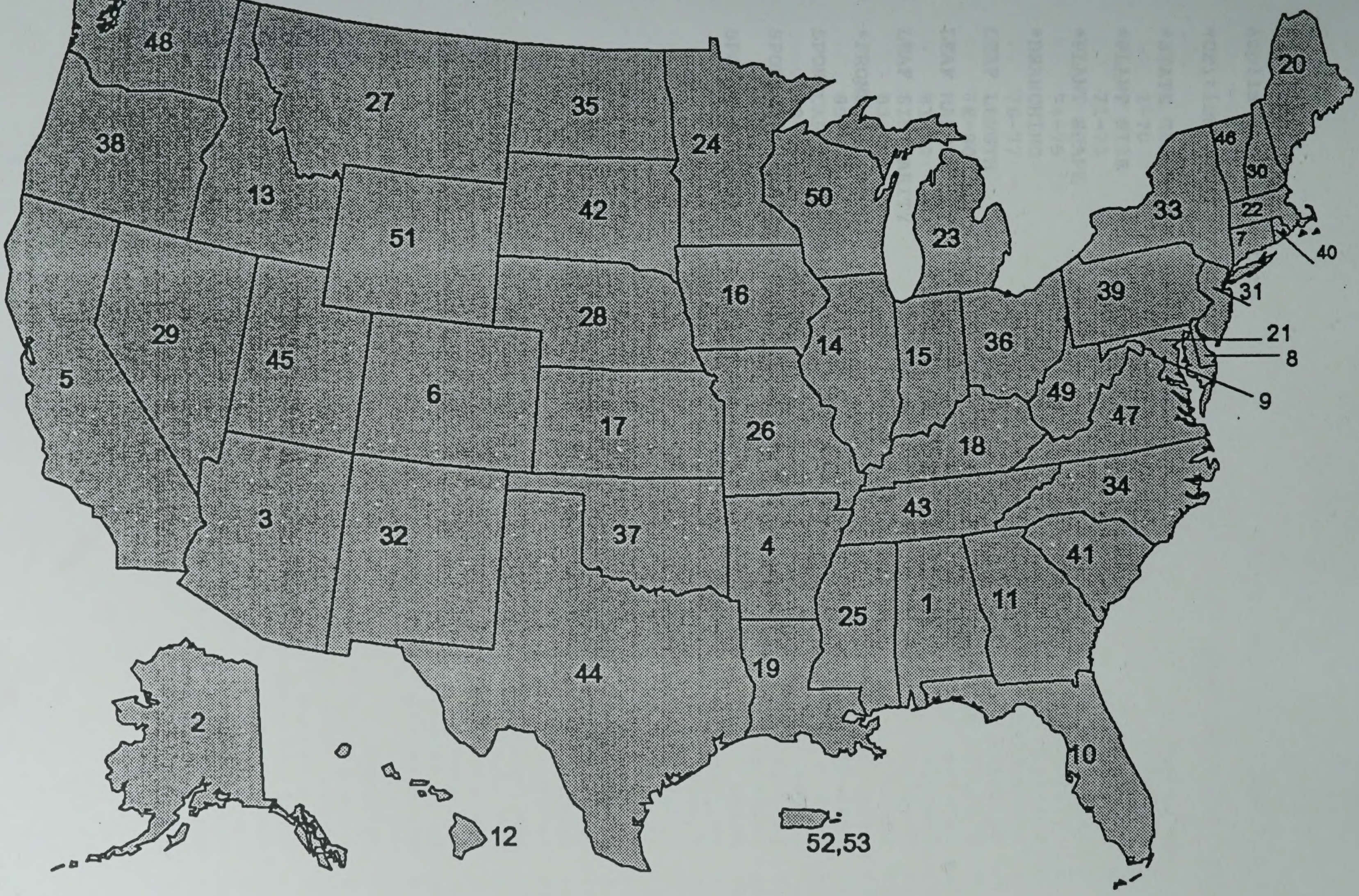
29 Cystopteris fragilis
30 Cystopteris montana
31 Deparia acrostichoides
50 Dicranopteris flexuosa
32 Diplazium pycnocarpon
35 Dryopteris clintoniana
34 Dryopteris celsa
33 Dryopteris carthusiana
40 Dryopteris ludoviciana
41 Dryopteris marginalis
37 Dryopteris expansa
36 Dryopteris cristata
39 Dryopteris intermedia
38 Dryopteris goldiana
43 Gymnocarpium robertianum
42 Gymnocarpium dryopteris
51 Hymenophyllum wrightii
22 Hypolepis repens
44 Lomariopsis kunzeana

Mosquito
& Water
Ferns Key

MOSQUITO AND WATER FERNS (AZOLLA)

General	Leaf	Sporocarp
Geography 1–70	Size 78–80	Position 88–89
Plant Size 71–73	Margin 81–82	Vestiture 90
Plant Shape 74–75	Similarity 83–84	Shape 91
Branching 76–77	Frond Position 85–87	

MARSH KEYS, STATE GEOGRAPHY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Azolla Key Characters

*Critical Characters

*STATE GEOGRAPHY
    1-70
*PLANT SIZE
    71-73
*PLANT SHAPE
    74-75
*BRANCHING
    76-77
LEAF LENGTH
    78-80
LEAF MARGIN
    81-82
LEAF SIMILARITY
    83-84
*FROND POSITION
    85-87
SPOROCARP POSITION
    88-89
SPOROCARP VESTITURE
    90
SPOROCARP SHAPE
    91

Azolla Key, 101 characters.

*Critical Characters

*State Geography
1 Alabama
2 Alaska
3 Arizona
4 Arkansas
5 California
6 Colorado
7 Connecticut
8 Delaware
9 District of Columbia
10 Florida
11 Georgia
12 Hawaii
13 Idaho
14 Illinois
15 Indiana
16 Iowa
17 Kansas
18 Kentucky
19 Louisiana
20 Maine
21 Maryland
22 Massachusetts
23 Michigan
24 Minnesota
25 Mississippi
26 Missouri
27 Montana
28 Nebraska
29 Nevada
30 New Hampshire
31 New Jersey
32 New Mexico
33 New York
34 North Carolina
35 North Dakota
36 Ohio
37 Oklahoma
38 Oregon
39 Pennsylvania
40 Rhode Island
41 South Carolina
42 South Dakota
43 Tennessee
44 Texas
45 Utah
46 Vermont
47 Virginia

48 **Washington**
49 **West Virginia**
50 **Wisconsin**
51 **Wyoming**
52 **Puerto Rico**
53 **Virgin Islands**
54 **Alberta**
55 **British Columbia**
56 **Franklin**
57 **Keewatin**
58 **Labrador**
59 **MacKenzie**
60 **Manitoba**
61 **New Brunswick**
62 **Newfoundland**
63 **Nova Scotia**
64 **Ontario**
65 **Prince Edward Island**
66 **Quebec**
67 **Saskatchewan**
68 **Yukon Territory**
69 **Greenland (Denmark)**
70 **St. Pierre and Miquelon Islands (France)**

*PLANT SIZE
71 **<1 cm**
72 **1-4 cm**
73 **>4 cm**

*PLANT SHAPE
74 **Round**
75 **Elongated**

*BRANCHING
76 **Dichotomous** (equally forked)
77 **Pinnate**

LEAF LENGTH
78 **<1 cm**
79 **1-1.5 cm**
80 **>1.5 cm**

LEAF MARGIN
81 **Papillate** (minute, nipple-shaped projections)
82 **Hyaline** (colorless and translucent)

LEAF SIMILARITY
83 **Lower leaf > upper leaf**
84 **Lower leaf = upper leaf**

*FROND POSITION
85 **Imbricately arranged** (overlapping, as shingles on a roof)
86 **Spaciously arranged**
87 **Simple**

SPOROCARP POSITION
88 **Sessile** (not stalked)
89 **Pedicelled** (stalked)

SPOROCARP VESTITURE
90 **Glabrous** (without hairs)

SPOROCARP SHAPE
91 **Elongated**

92 (Blank character for expansion)
93 (Blank character for expansion)
94 (Blank character for expansion)
95 (Blank character for expansion)
96 (Blank character for expansion)
97 (Blank character for expansion)
98 (Blank character for expansion)
99 (Blank character for expansion)
100 (Blank character for expansion)
101 (Blank character for expansion)

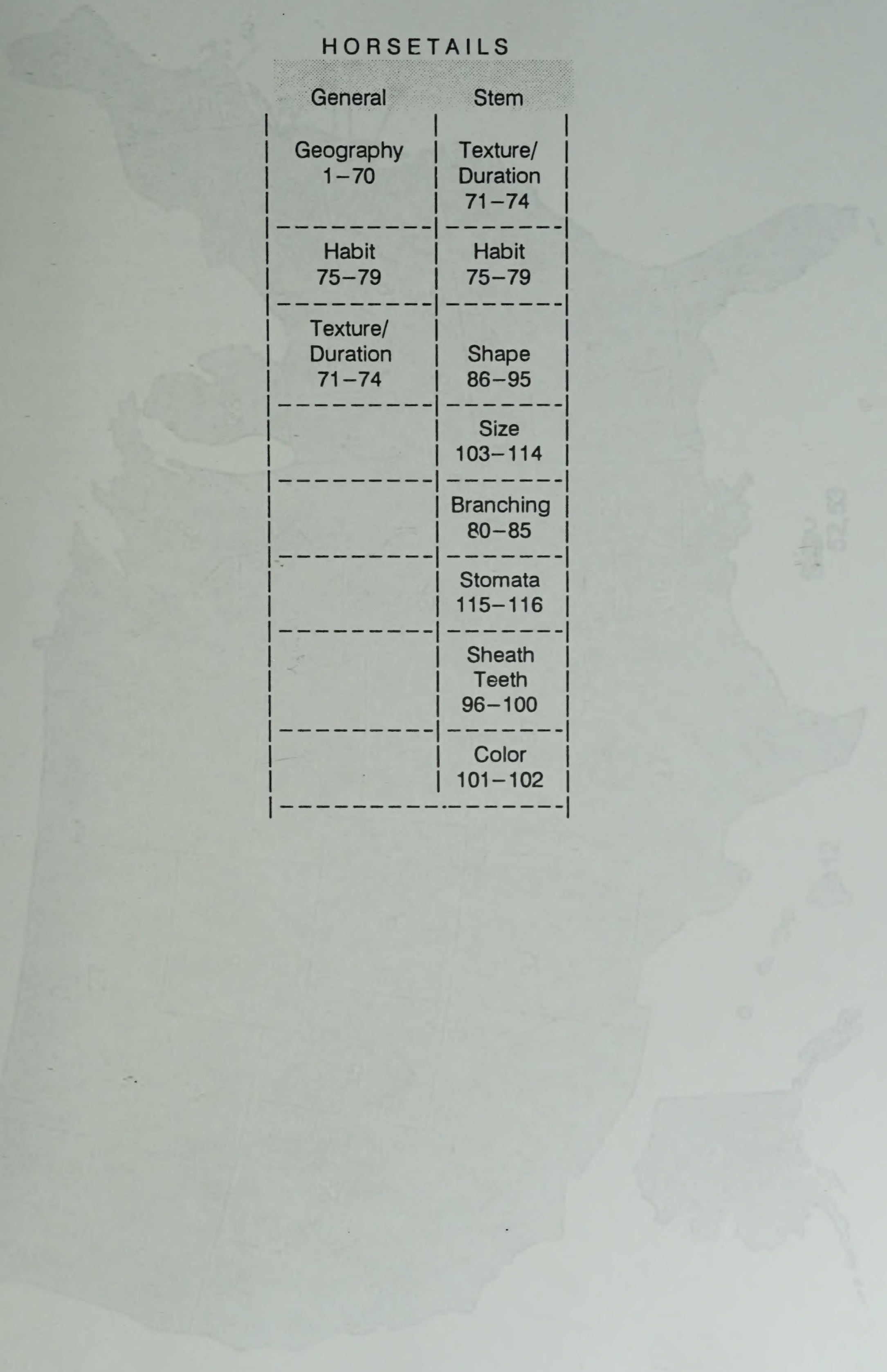
Azolla Key,   5 taxa.

1 Azolla caroliniana
2 Azolla filiculoides
3 Azolla mexicana
4 Salvinia auriculata
5 Salvinia minima

HORSETAILS
KEY

HORSETAILS

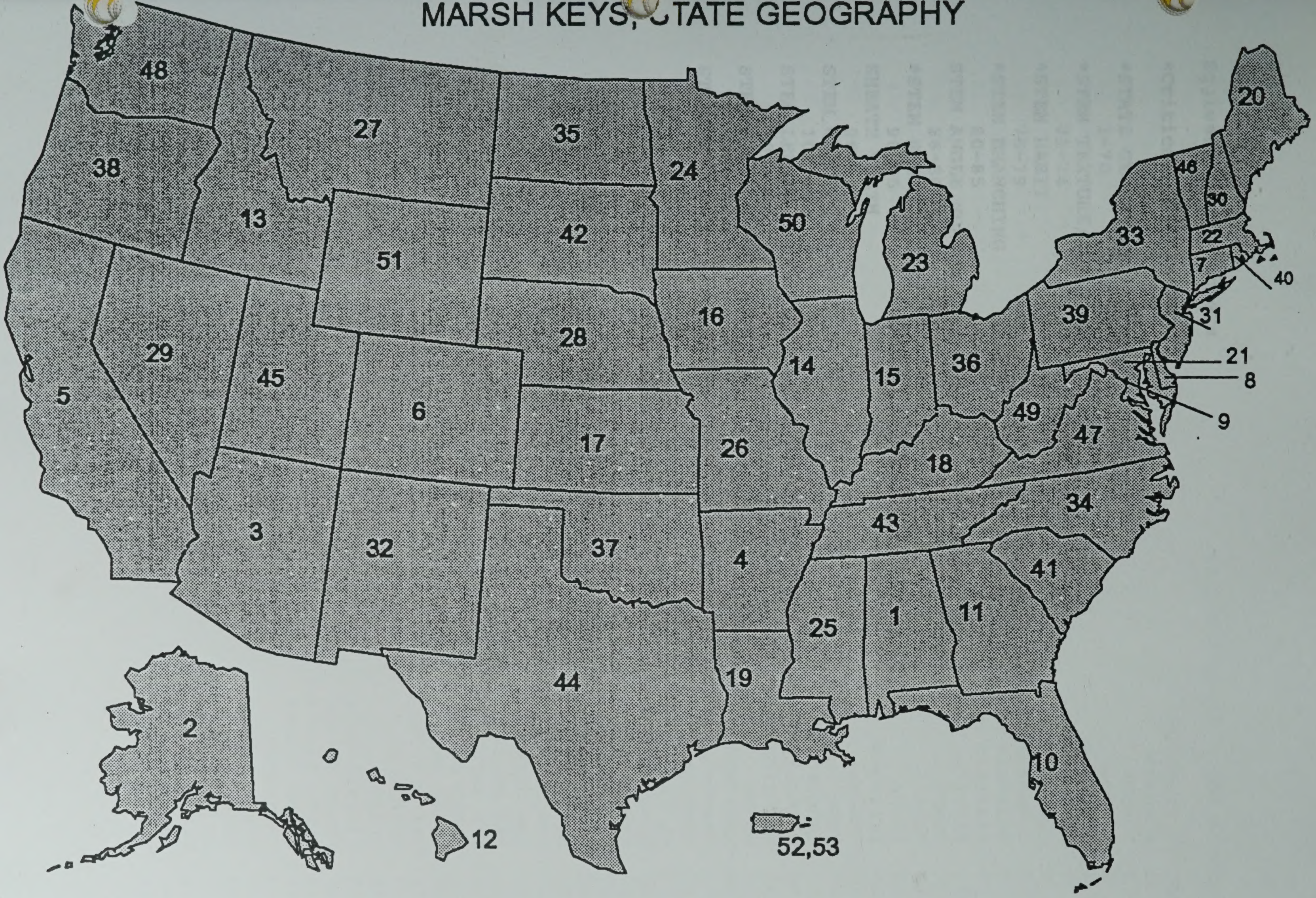
KEY



HORSETAILS

General	Stem
Geography 1–70	Texture/ Duration 71–74
Habit 75–79	Habit 75–79
Texture/ Duration 71–74	Shape 86–95
	Size 103–114
	Branching 80–85
	Stomata 115–116
	Sheath Teeth 96–100
	Color 101–102

MARSH KEYS, STATE GEOGRAPHY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Equiset Key Characters

*Critical Characters

*STATE GEOGRAPHY
 1-70
*STEM TEXTURE/DURATION
 71-74
*STEM HABIT
 75-79
*STEM BRANCHING
 80-85
STEM ANGLE NUMBER
 86-89
*STEM RIDGE NUMBER
 90-95
SHEATH TEETH
 96-100
STEM COLOR
 101-102
STEM LENGTH
 103-108
STEM WIDTH
 109-114
STOMATA
 115-116

Equiset Key, 116 characters.

*STATE GEOGRAPHY
1 **Alabama**
2 **Alaska**
3 **Arizona**
4 **Arkansas**
5 **California**
6 **Colorado**
7 **Connecticut**
8 **Delaware**
9 **District of Columbia**
10 **Florida**
11 **Georgia**
12 **Hawaii**
13 **Idaho**
14 **Illinois**
15 **Indiana**
16 **Iowa**
17 **Kansas**
18 **Kentucky**
19 **Louisiana**
20 **Maine**
21 **Maryland**
22 **Massachusetts**
23 **Michigan**
24 **Minnesota**
25 **Mississippi**
26 **Missouri**
27 **Montana**
28 **Nebraska**
29 **Nevada**
30 **New Hampshire**
31 **New Jersey**
32 **New Mexico**
33 **New York**
34 **North Carolina**
35 **North Dakota**
36 **Ohio**
37 **Oklahoma**
38 **Oregon**
39 **Pennsylvania**
40 **Rhode Island**
41 **South Carolina**
42 **South Dakota**
43 **Tennessee**
44 **Texas**
45 **Utah**
46 **Vermont**
47 **Virginia**
48 **Washington**
49 **West Virginia**

50 **Wisconsin**
51 **Wyoming**
52 **Puerto Rico**
53 **Virgin Islands**
54 **Alberta**
55 **British Columbia**
56 **Franklin**
57 **Keewatin**
58 **Labrador**
59 **MacKenzie**
60 **Manitoba**
61 **New Brunswick**
62 **Newfoundland**
63 **Nova Scotia**
64 **Ontario**
65 **Prince Edward Island**
66 **Quebec**
67 **Saskatchewan**
68 **Yukon Territory**
69 **Greenland (Denmark)**
70 **St. Pierre and Miquelon Islands (France)**

*STEM TEXTURE/DURATION

71 **Evergreen** (persistent leaves remain green during the dormant or winter season)
72 **Deciduous** (leaves fall at end of one season of growth)
73 **Annual** (living for one or two seasons)
74 **Perennial** (living several to many seasons)

*STEM HABIT

75 **Dimorphic** (having two forms)
76 **Monomorphic** (having a single form)
77 **Tufted or in clumps**
78 **Erect/ascending**
79 **Prostrate**

*STEM BRANCHING

80 **Unbranched**
81 **Whorled** (3 or more parts inserted at a single point)
82 **Simple**
83 **Forked**
84 **Regular**
85 **Irregular**

STEM ANGLE NUMBER

86 **0**
87 **3**
88 **4-5**
89 **>5**

*STEM RIDGE NUMBER

90	<3
91	4-5
92	6-10
93	11-15
94	16-25
95	>25

SHEATH TEETH

96	0 on fertile stem
97	1-5 on sterile stem
98	6-10 on sterile stem
99	11-20 on sterile stem
100	>20 on sterile stem

STEM COLOR

101	0-1 bands at nodes
102	2 bands at nodes

STEM LENGTH

103	<5 cm
104	5-10 cm
105	10-15 cm
106	15-25 cm
107	25-50 cm
108	>50 cm

STEM WIDTH

109	<1 mm
110	1-2 mm
111	2-3 mm
112	3-5 mm
113	5-10 mm
114	>10 mm

STOMATA

115	Scattered
116	In rows

Equiset Key, 10 taxa.

1 Equisetum arvense
2 Equisetum fluviatile
3 Equisetum hyemale
4 Equisetum laevigatum
5 Equisetum palustre
6 Equisetum pratense
7 Equisetum scirpoides
8 Equisetum sylvaticum
9 Equisetum telmateia
10 Equisetum variegatum

Quickest
Key

STEM RIDGE NUMBER
90 <3
91 4-5
92 6-10
93 11-15
94 16-25
95 >25

SHEATH TEETH
96 0 on fertile stem
97 1-5 on sterile stem
98 6-10 on sterile stem
99 11-20 on sterile stem
100 >20 on sterile stem

STEM COLOR
101 0-1 bands at nodes
102 2 bands at nodes

STEM LENGTH
103 <5 cm
104 5-10 cm
105 10-15 cm
106 15-25 cm
107 25-50 cm
108 >50 cm

STEM WIDTH
109 <1 mm
110 1-2 mm
111 2-3 mm
112 3-5 mm
113 5-10 mm
114 >10 mm

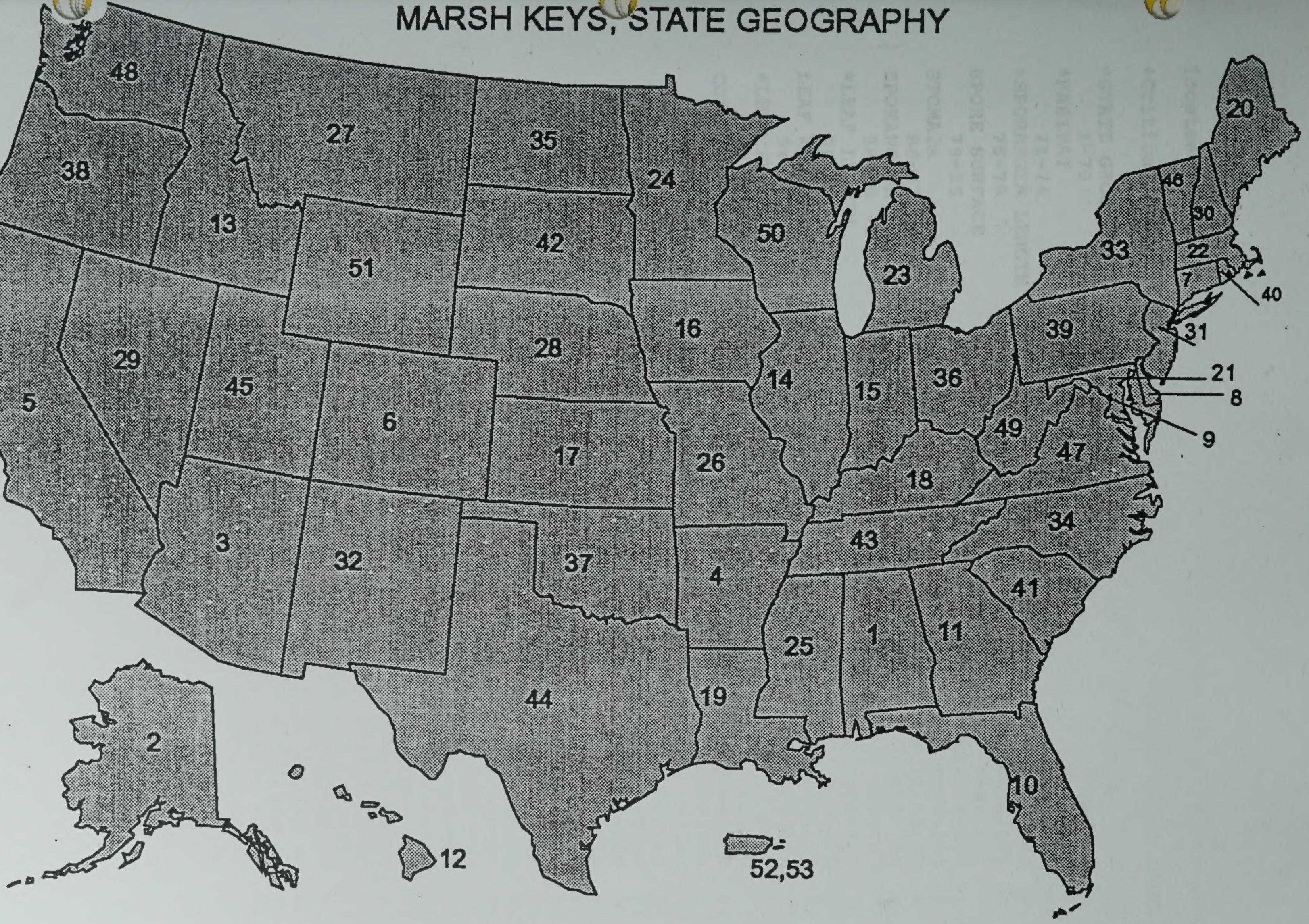
STOMATA
115 scattered
116 in rows

Quiliworts
Key

QUILLWORTS

General	Leaf	Stem	Spore/ Sporangium	Corm
Geography 1–70	Size 90–97	Stomata 86–87	Size 75–78	Lobing 101–102
Habitat 71–74	Shape 98–100		Surface 79–85 88–89	

MARSH KEYS, STATE GEOGRAPHY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Isoetes Key Characters

*Critical Characters

*STATE GEOGRAPHY
1-70
*HABITAT
71-74
*SPORANGIA LENGTH
75-78
SPORE SURFACE
79-85
STOMATA
86-87
SPORANGIUM SURFACE
88-89
*LEAF LENGTH
90-93
LEAF WIDTH
94-97
*LEAF SHAPE
98-100
CORM LOBING
101-102

Isoetes Key, 112 characters

*Critical Characters

*STATE GEOGRAPHY
1 **Alabama**
2 **Alaska**
3 **Arizona**
4 **Arkansas**
5 **California**
6 **Colorado**
7 **Connecticut**
8 **Delaware**
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41 **South Carolina**
42 **South Dakota**
43 **Tennessee**
44 **Texas**
45 **Utah**
46 **Vermont**
47 **Virginia**

48 Washington
49 West Virginia
50 Wisconsin
51 Wyoming
52 Puerto Rico
53 Virgin Islands
54 Alberta
55 British Columbia
56 Franklin
57 Keewatin
58 Labrador
59 MacKenzie
60 Manitoba
61 New Brunswick
62 Newfoundland
63 Nova Scotia
64 Ontario
65 Prince Edward Island
66 Quebec
67 Saskatchewan
68 Yukon Territory
69 Greenland (Denmark)
70 St. Pierre and Miquelon Islands (France)

*HABITAT

71 Plants amphibious
72 Plants terrestrial
73 Plants aquatic
74 Plants epipetric (growing on rocks)

*SPORANGIA LENGTH

75 1-2 mm
76 2.5-5 mm
77 6-10 mm
78 >10 mm

SPORE SURFACE

79 Spore reticulum loose (reticulum: mesh-like network)
80 Spore reticulum cobwebby
81 Spore reticulum dense
82 Peripheral strands present (longitudinal strengthening strands in the leaves)
83 Spore microspines absent (microspine: spine on spore surface)
84 Spore microspines short
85 Spore microspines long

STOMATA

86 Absent
87 Present

SPORANGIUM SURFACE
88 Velum covering sporangium 25-75% (on abaxial surface of leaf base)
89 Velum covering sporangium 100%

*LEAF LENGTH
90 <4 cm
91 4-10 cm
92 10-20 cm
93 >20 cm

LEAF WIDTH
94 <0.3 cm
95 0.3-0.5 cm
96 0.5-1.0 cm
97 >1.0 cm

*LEAF SHAPE
98 Recurved
99 Erect
100 Twisted

CORM LOBING
101 2-lobed
102 3-lobed

103 (Blank character for expansion)
104 (Blank character for expansion)
105 (Blank character for expansion)
106 (Blank character for expansion)
107 (Blank character for expansion)
108 (Blank character for expansion)
109 (Blank character for expansion)
110 (Blank character for expansion)
111 (Blank character for expansion)
112 (Blank character for expansion)

Isoetes Key, 15 taxa.

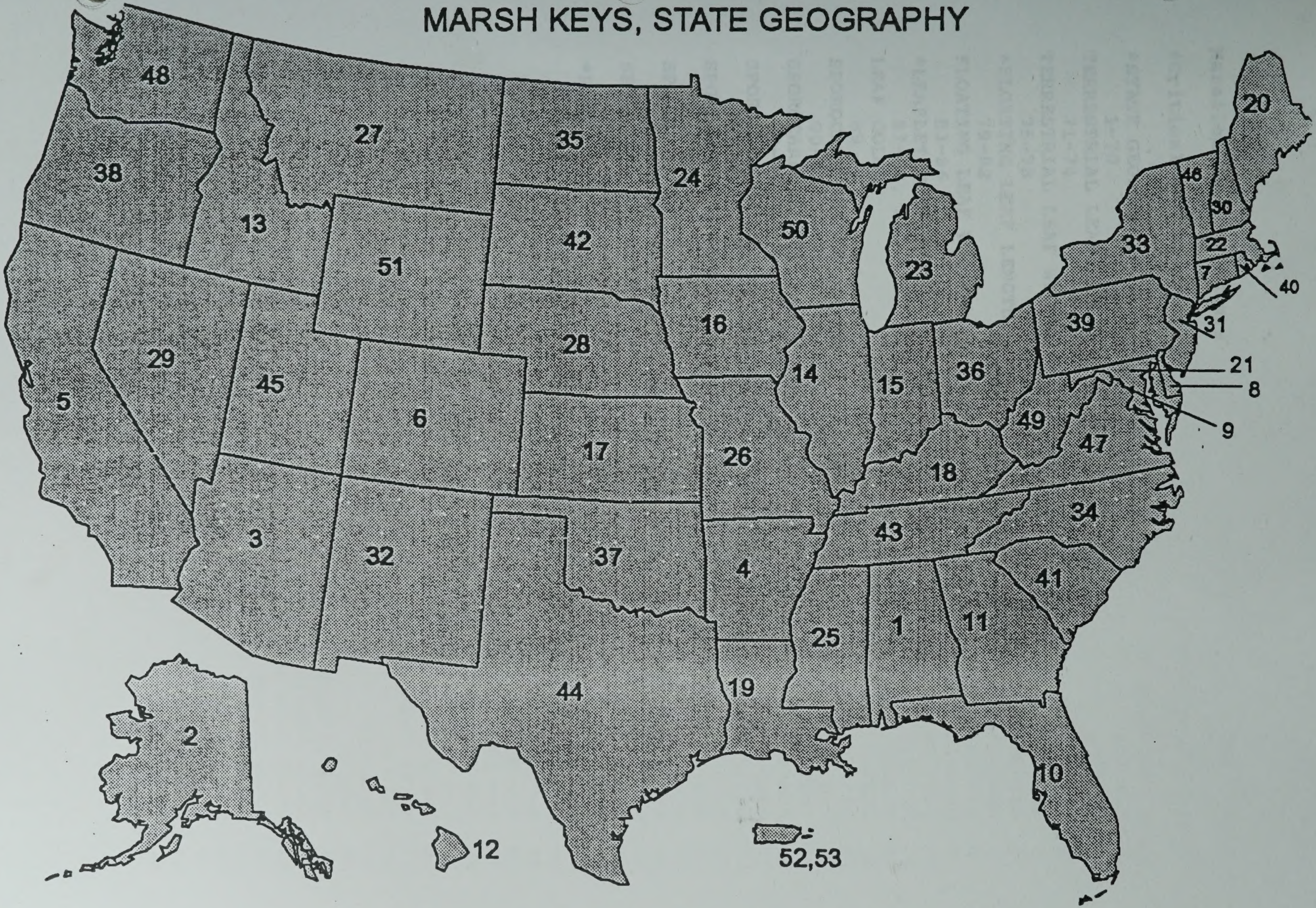
1 Isoetes bolanderi
2 Isoetes butleri
3 Isoetes echinospora
4 Isoetes engelmannii
5 Isoetes flaccida
6 Isoetes howellii
7 Isoetes lacustris
8 Isoetes lithophila
9 Isoetes melanopoda
10 Isoetes melanospora
11 Isoetes nuttallii
12 Isoetes piedmontana
13 Isoetes riparia
14 Isoetes tegetiformans
15 Isoetes tuckermanii

WATER-
CLOVERS
KEY

WATER–CLOVERS (MARSILEA)

General	Leaf	Sporocarp	Root
Geography 1–70	Size 71–86	Number 90–92	Position 109–110
	Vestiture/ Color 87–89 111	Size 93–103	
		Teeth 104–106	
		Peduncle 107–108	

MARSH KEYS, STATE GEOGRAPHY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Marsilea Key Characters

*Critical Characters

*STATE GEOGRAPHY
   1-70
TERRESTRIAL LEAF LENGTH
   71-74
TERRESTRIAL LEAF WIDTH
   75-78
*FLOATING LEAF LENGTH
   79-82
FLOATING LEAF WIDTH
   83-86
*LEAFLET VESTITURE
   87-88, 111
LEAF COLOR
   89
SPOROCARP NUMBER
   90-92
SPOROCARP LENGTH
   93-96
SPOROCARP WIDTH
   97-100
SPOROCARP THICKNESS
   101-103
SPOROCARP TEETH
   104-106
SPOROCARP PEDUNCLE
   107-108
*ROOT POSITION
   109-110

Marsilea Key, 121 characters.

*Critical Characters

*STATE GEOGRAPHY
1 Alabama
2 Alaska
3 Arizona
4 Arkansas
5 California
6 Colorado
7 Connecticut
8 Delaware
9 District of Columbia
10 Florida
11 Georgia
12 Hawaii
13 Idaho
14 Illinois
15 Indiana
16 Iowa
17 Kansas
18 Kentucky
19 Louisiana
20 Maine
21 Maryland
22 Massachusetts
23 Michigan
24 Minnesota
25 Mississippi
26 Missouri
27 Montana
28 Nebraska
29 Nevada
30 New Hampshire
31 New Jersey
32 New Mexico
33 New York
34 North Carolina
35 North Dakota
36 Ohio
37 Oklahoma
38 Oregon
39 Pennsylvania
40 Rhode Island
41 South Carolina
42 South Dakota
43 Tennessee
44 Texas
45 Utah
46 Vermont
47 Virginia

48 Washington
49 West Virginia
50 Wisconsin
51 Wyoming
52 Puerto Rico
53 Virgin Islands
54 Alberta
55 British Columbia
56 Franklin
57 Keewatin
58 Labrador
59 MacKenzie
60 Manitoba
61 New Brunswick
62 Newfoundland
63 Nova Scotia
64 Ontario
65 Prince Edward Island
66 Quebec
67 Saskatchewan
68 Yukon Territory
69 Greenland (Denmark)
70 St. Pierre and Miquelon Islands (France)

TERRESTRIAL LEAF LENGTH
71 <0.5 cm
72 0.5-1.5 cm
73 1.5-2 cm
74 >2 cm

TERRESTRIAL LEAF WIDTH
75 <0.5 cm
76 0.5-1.5 cm
77 1.5-2 cm
78 >2 cm

*FLOATING LEAF LENGTH
79 <1 cm
80 1-2 cm
81 2-3 cm
82 >3 cm

FLOATING LEAF WIDTH
83 <1 cm
84 1-2 cm
85 2-3 cm
86 >3 cm

*LEAFLET VESTITURE
87 Golden hairy beneath
88 White hairy beneath
111 Leaflets hairy

LEAF COLOR
89 **Lower (ventral) surface red-streaked**

SPOROCARP NUMBER
90 **1-2**
91 **3**
92 **4**

SPOROCARP LENGTH
93 **<3 mm**
94 **3-6 mm**
95 **6-8 mm**
96 **>8 mm**

SPOROCARP WIDTH
97 **<3 mm**
98 **3-4 mm**
99 **4-6 mm**
100 **>6 mm**

SPOROCARP THICKNESS
101 **<2 mm**
102 **2-3 mm**
103 **>3 mm**

SPOROCARP TEETH
104 **Inferior tooth present**
105 **Superior tooth acute**
106 **Superior tooth blunt or absent**

SPOROCARP PEDUNCLE
107 **Recurved**
108 **Erect**

*ROOT POSITION
109 **Roots found at nodes only**
110 **Roots found at nodes and internodes**

112 (Blank character for expansion)
113 (Blank character for expansion)
114 (Blank character for expansion)
115 (Blank character for expansion)
116 (Blank character for expansion)
117 (Blank character for expansion)
118 (Blank character for expansion)
119 (Blank character for expansion)
120 (Blank character for expansion)
121 (Blank character for expansion)

Marsilea Key, 4 taxa.

1 Marsilea ancylopoda
2 Marsilea macropoda
3 Marsilea quadrifolia
4 Marsilea vestita

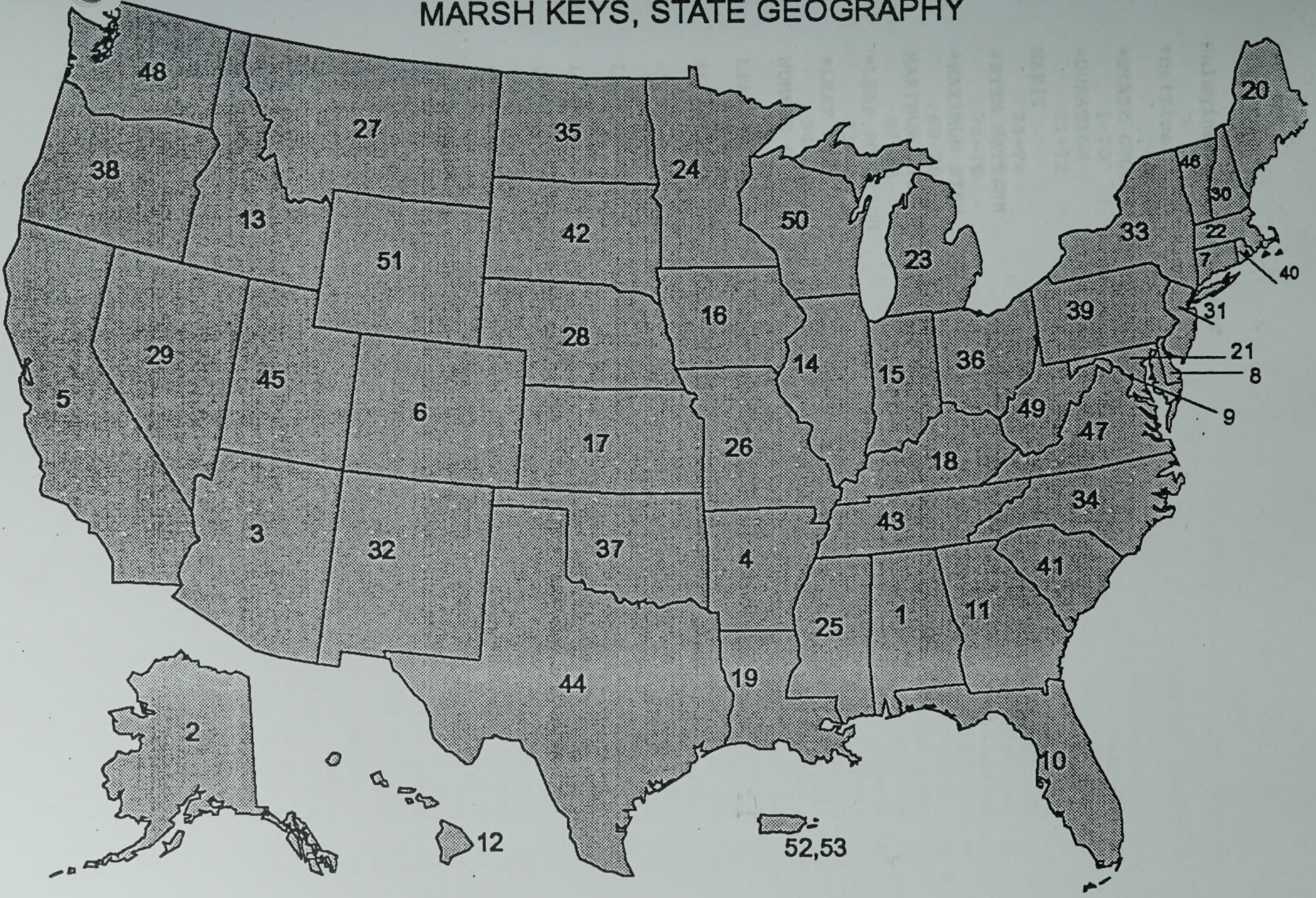
Spike
Mosses
Key

Spike-
mosses
Key

SPIKE – MOSSES

General	Leaf	Stem	Cone
Geography 1–70	Margin 96 105–107	Size 80–92	Size 123–131
Duration 71–72	Size 108–116	Texture/ Duration 71–72 103–104	Sporangia Not in Cone 117
Habit 73–74	Position/ Shape 93–95 97–102	Pattern 75–79	Position 120–122
			Number 118–119

MARSH KEYS, STATE GEOGRAPHY


48
27
35
24
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51
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16
28
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18
34
43
3
37
32
41
4
1
11
25
19
44
10
2
12
52,53

Selagine Key Characters

*Critical Characters

*STATE GEOGRAPHY
1-70
*DURATION
71-72
HABIT
73-74
*STEM PATTERN
75-79
*MAXIMUM STEM LENGTH
80-86
MAXIMUM STEM WIDTH
87-92
*LEAF POSITION
93-95
*LEAF APEX
96
NUMBER OF LEAF RANKS
97-100
LEAF SHAPE
101-102
*LEAF DURATION
103-104
*LEAF MARGIN
105-107
LEAF LENGTH
108-112
LEAF WIDTH
113-116
*CONES PER STEM
117-119
*CONE POSITION
120-122
CONE LENGTH
123-127
CONE WIDTH
128-131

Selagine Key, 141 characters.

*Critical Characters

*State Geography

1 **Alabama**
2 **Alaska**
3 **Arizona**
4 **Arkansas**
5 **California**
6 **Colorado**
7 **Connecticut**
8 **Delaware**
9 **District of Columbia**
10 **Florida**
11 **Georgia**
12 **Hawaii**
13 **Idaho**
14 **Illinois**
15 **Indiana**
16 **Iowa**
17 **Kansas**
18 **Kentucky**
19 **Louisiana**
20 **Maine**
21 **Maryland**
22 **Massachusetts**
23 **Michigan**
24 **Minnesota**
25 **Mississippi**
26 **Missouri**
27 **Montana**
28 **Nebraska**
29 **Nevada**
30 **New Hampshire**
31 **New Jersey**
32 **New Mexico**
33 **New York**
34 **North Carolina**
35 **North Dakota**
36 **Ohio**
37 **Oklahoma**
38 **Oregon**
39 **Pennsylvania**
40 **Rhode Island**
41 **South Carolina**
42 **South Dakota**
43 **Tennessee**
44 **Texas**
45 **Utah**
46 **Vermont**
47 **Virginia**

48 Washington
49 West Virginia
50 Wisconsin
51 Wyoming
52 Puerto Rico
53 Virgin Islands
54 Alberta
55 British Columbia
56 Franklin
57 Keewatin
58 Labrador
59 MacKenzie
60 Manitoba
61 New Brunswick
62 Newfoundland
63 Nova Scotia
64 Ontario
65 Prince Edward Island
66 Quebec
67 Saskatchewan
68 Yukon Territory
69 Greenland (Denmark)
70 St. Pierre and Miquelon Islands (France)

*DURATION
71 Annual (living for one or two years)
72 Perennial (living several to many seasons)

HABIT
73 Terrestrial
74 Epiphytic (growing on plants)

*STEM PATTERN
75 Horizontal stem underground
76 Horizontal stem above ground
77 Stem branches forked or dichotomous
78 Stem branches in fan-like sprays
79 Stem branches simple or monopodial

*MAXIMUM STEM LENGTH
80 <2 cm
81 2-5 cm
82 5-10 cm
83 10-20 cm
84 20-35 cm
85 35-45 cm
86 >45 cm

MAXIMUM STEM WIDTH
87 **<2 mm**
88 **2-4 mm**
89 **4-6 mm**
90 **6-10 mm**
91 **10-15 mm**
92 **>15 mm**

*LEAF POSITION
93 **Appressed to stem** (pressed flat against stem)
94 **Pointing downward on stem** (decurrent)
95 **Erect, ascending, or spreading on stem**

*LEAF APEX
96 **Bristle tip of leaf = blade length**

NUMBER OF LEAF RANKS
97 **4**
98 **6**
99 **8**
100 **10+**

LEAF SHAPE
101 **Dimorphic** (having 2 forms)
102 **Monomorphic** (having 1 form)

*LEAF DURATION
103 **Evergreen** (persistent leaves remain green during dormant season)
104 **Deciduous** (leaves fall at end of one season of growth)

*LEAF MARGIN
105 **Entire** (without teeth)
106 **Toothed**
107 **White**

LEAF LENGTH
108 **<2 mm**
109 **2-4 mm**
110 **4-6 mm**
111 **6-8 mm**
112 **>8 mm**

LEAF WIDTH
113 **<0.5 mm**
114 **0.5-1 mm**
115 **1-2 mm**
116 **>2 mm**

*CONES PER STEM
117 **0 (Sporangia not in cones)**
118 **1**
119 **2+**

*CONE POSITION
120 **Erect** (stem upright)
121 **Pendulous** (hanging down)
122 **Ascending** (rising obliquely or curving upward)

CONE LENGTH
123 **<1 mm**
124 **1-3 mm**
125 **3-6 mm**
126 **6-10 mm**
127 **>10 mm**

CONE WIDTH
128 **<2 mm**
129 **2-4 mm**
130 **4-6 mm**
131 **>6 mm**

132 (Blank character for expansion)
133 (Blank character for expansion)
134 (Blank character for expansion)
135 (Blank character for expansion)
136 (Blank character for expansion)
137 (Blank character for expansion)
138 (Blank character for expansion)
139 (Blank character for expansion)
140 (Blank character for expansion)
141 (Blank character for expansion)

Selagine Key,   21 taxa.

1	Huperzia lucidula
2	Huperzia porophila
3	Huperzia selago
4	Lycopodiella alopecuroides
5	Lycopodiella appressa
6	Lycopodiella caroliniana
7	Lycopodiella cernua
8	Lycopodiella inundata
9	Lycopodiella prostrata
10	Lycopodium alpinum
11	Lycopodium annotinum
12	Lycopodium clavatum
13	Lycopodium complanatum
14	Lycopodium dendroideum
15	Lycopodium obscurum
16	Psilotum nudum
17	Selaginella apoda
18	Selaginella armata
19	Selaginella ludoviciana
20	Selaginella selaginoides
21	Selaginella uncinata

MEKA Manual

Version 1.3 for MS–DOS

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Selagine Key: 21 taxa.

1 Huperzia lucidula
2 Huperzia porophila
3 Huperzia selago
4 Lycopodiella alopecuroides
5 Lycopodiella appressa
6 Lycopodiella caroliniana
7 Lycopodiella cernua
8 Lycopodiella inundata
9 Lycopodiella prostrata
10 Lycopodium alpinum
11 Lycopodium annotinum
12 Lycopodium clavatum
13 Lycopodium complanatum
14 Lycopodium dendroideum
15 Lycopodium obscurum
16 Psilotum nudum
17 Selaginella apoda
18 Selaginella armata
19 Selaginella ludoviciana
20 Selaginella selaginoides
21 Selaginella uncinata

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MEKA (Version 1.3)[1]
MEKAEDIT (Version 1.3)

A GENERAL PURPOSE MULTIPLE-ENTRY KEY ALGORITHM AND EDITOR

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MEKA is an interactive Multiple-Entry Key Algorithm that allows identification of an unknown specimen or the characterization of a group of taxa. The program MEKAEDIT allows users to make their own keys for access by MEKA. These programs are written in Turbo Pascal and run on microcomputers using PC-DOS operating systems that have at least 256k bytes of memory. We distribute the programs on an IBM PC-DOS formatted disk for running on IBM-compatible machines. Two keys to angiosperm families are included as examples of the application of these programs. The programs MEKA and MEKAEDIT can be copied and given to others as long as this distribution is not for profit. The two keys, ANGIOFAM and TROPIFAM, are supplied with MEKA at no cost to users. Because of copyright restrictions imposed by the Department of Botany of the British Museum (Natural History), we must maintain a roster of all recipients of ANGIOFAM. Please contact Duncan and Meacham at the above address for permission to copy ANGIOFAM. We would appreciate knowing about users who have received the program from another source, about other keys that have been developed, and about additional features that would be desirable. We will send users who are known to us information about updates to the programs and additional keys.

DOCUMENTATION FOR MEKA

In order to attain flexibility, MEKA does not lead the user in a fixed, stepwise fashion through a series of questions to which the user must respond. Instead, the user can issue MEKA commands in any sequence. MEKA keeps track of the results of commands by maintaining lists of "active characters" and "active taxa." In order to understand how to use MEKA, it is necessary to understand how these lists influence MEKA commands and how MEKA commands alter the lists. It is true that this flexibility places a greater initial burden on the user who must know how to proceed without prompting from the program. After some experience with MEKA, we hope that the user will find that this approach enhances MEKA's utility. We have included a tutorial below that will help first-time users gain experience in the use of MEKA.

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Characters become active when they are used to key out a specimen. The user can add or delete characters from the list of active characters as desired. MEKA calculates the number of mismatched active characters for each taxon. For example, if we have indicated to MEKA that a given character state is present in a specimen and the data set shows that the character state is absent for a particular taxon, then that taxon is considered mismatched for that character. MEKA maintains a list of the number of mismatches for each taxon in the data set. The user causes taxa to become active by selecting sets of taxa on the basis of number of mismatched characters or by explicitly making them active without regard for number of mismatches. MEKA allows the character states of active taxa to be listed in several ways. The lists of active characters and active taxa cause results of previous commands to influence the outcome of subsequent commands.

STRUCTURE OF KEYS USED BY MEKA

A MEKA key consists of four disk files. One file contains text that describes the nature and source of the data, a second contains brief descriptions of the characters used in the key, a third contains the names of the taxa used in the key, and a fourth contains the data matrix arranged as characters by taxa. Additional details about the structure of these files are given below. The names of these files consist of the name of the key plus a three letter extension that designates the type of file. The two keys we distribute are called ANGIOFAM and TROPIFAM. ANGIOFAM is a key based on the data of Hansen and Rahn to identify flowering plant families. The four files for the key ANGIOFAM are named ANGIOFAM.DES, ANGIOFAM.CHR, ANGIOFAM.TAX, and ANGIOFAM.DAT, respectively. Most users will be able to maintain all of these data files on a single floppy diskette. In the event that this is not possible, MEKA allows for users to designate the disk drive that contains each of the four files.

The character state of a single taxon can have one of four values in the data matrix file (.DAT). The value '+' indicates presence of the character state in all members of the taxon, a '-' indicates the absence of that state from the taxon, a '*' indicates that the state is present in some but not all members of the taxon, and a '?' indicates that the condition of that state is not known for the taxon. Because of the nature of the original punched-card keys on which ANGIOFAM and TROPIFAM are based, these keys use only the states '*' and '-'.

CONTENTS OF THE STANDARD PC-DOS 5.25 INCH DISTRIBUTION DISKETTE

The PC-DOS distribution diskette is a double-sided, double-density (360k) 5.25 inch diskette that should be readable by PC-DOS systems that are version 2.0 or higher. These files are included:

MEKA.COM	The executable MEKA program
MEKAEDIT.COM	The executable MEKAEDIT program
MEKAEDIT.PAS	The Pascal source code for MEKAEDIT
MEKA.DOC	The documentation for MEKA and MEKAEDIT

ANGIOFAM key:

ANGIOFAM.DES	The ANGIOFAM description file
ANGIOFAM.TAX	The ANGIOFAM taxon name file
ANGIOFAM.CHR	The ANGIOFAM character description file
ANGIOFAM.DAT	The ANGIOFAM data matrix

TROPIFAM key:

TROPIFAM.DES	The TROPIFAM description file
TROPIFAM.TAX	The TROPIFAM taxon name file
TROPIFAM.CHR	The TROPIFAM character description file
TROPIFAM.DAT	The TROPIFAM data matrix

COPYING MEKA TO YOUR SYSTEM

1. Dual floppy disk systems less than 360k bytes per diskette.

Use your operating system command to examine the directory of the master diskette. Use your operating system copy command to copy the files with extent .DAT to one diskette. Copy the remaining files to a diskette that contains the operating system so that you can boot your system using this second diskette.

2. Dual floppy disk systems with more than 360k bytes per diskette.

Use your operating system copy command to transfer all files from the master diskette to a single diskette that contains the operating system so that you can boot you system using this diskette.

3. Hard disk systems.

Use your operating system copy command to transfer all files to the user area or directory on the hard disk that you will use to run MEKA. If you are fortunate enough to have two hard disks, putting the '.DAT' file on a different disk will make disk access a bit faster.

RUNNING MEKA THE FIRST TIME

If you have a floppy disk system, place the diskette that contains the MEKA files and the operating system in drive A and log in drive A. If two disks are required to hold all files, place the other diskette in drive B. If you have a hard disk, log in the user area or directory that contains MEKA and the data files. Type 'MEKA' to begin the program. If two diskettes are required to hold all the files, precede the name of the key to be used with a colon (':') so that MEKA prompts you for the drive that contains each of the four files for the key you wish to use, e.g. type ':ANGIOFAM' instead of 'ANGIOFAM'. At this point, MEKA is ready to access the key.

OVERVIEW OF THE USE OF MEKA

Most uses of MEKA fall into two main categories: (1) the identification of an unknown or (2) the characterization of a taxon or set of taxa. Before describing the specific commands, we outline each of these two tasks.

In the identification of an unknown specimen, the sequence of operations is: (1) develop a character list using the characters displayed by a specimen, (2) key out a specimen, (3) select taxa that match the characters chosen or lack one or more of these characters, (4) search data for other characters that separate candidate taxa, and (5) choose additional characters if needed.

In the characterization of a set of taxa, the sequence of operations is: (1) select a set of taxa for examination and (2) search data for characters uniformly present, absent, variable or unknown in this set of taxa.

A SHORT MEKA TURTORIAL

To view the descriptions of character states, type '>'. The first fifteen character state descriptions will be displayed. The two symbols '>' and '<' will allow you to move through the descriptions and view them, fifteen at a time. To jump to a particular character, say number 100, use the VC (View Characters) command. Type 'VC 100' and hit enter. Descriptions 100 through 114 will be displayed. Try '<' and '>' now. To switch to viewing taxon names, type 'VT' and hit enter. Symbols '<' and '>' will now display taxon names. 'VT 100' [enter] will jump to taxon number 100. To go back to character descriptions, type 'VC' [enter].

The user can get a summary of the MEKA commands at any time by entering '?' [enter] or 'MC' [enter]. Try these commands.

Now we can key out a specimen. The AC (Add Character) command lets us select character states that are present (or absent) in the specimen we wish to identify. View the first fifteen characters by typing 'VC 1' [enter]. If our plant is herbaceous, we can tell MEKA that character 2 is present by typing 'AC 2' [no enter]. Type '>' to view characters 16 through 30. Note that the add character command reappears at the bottom of the screen. Type '18 21' to indicate that characters 18 and 21 are present. If we want to stop entering characters, and key out with the characters we already have, just type [enter] to end the add character command and then type 'KO' [enter] (for Key Out). MEKA will then search the data matrix for the three characters we have entered. Under KEY CHARACTERS SEARCHED, MEKA lists the characters as it searches them. The '+' after each character number means that we have indicated that each of these characters is present in the specimen at hand. Note that for both keys ANGIOFAM and TROPIFAM, absences of characters will not exclude any taxon as possibility and so absences are essentially meaningless for these two keys. New keys that are developed to use with MEKA need not be limited in this way. Under the heading TAXON SUMMARY BASED ON CHARACTER SEARCH, MEKA tells us that three taxa match the three characters we entered; 200 miss by one character; 177 miss by two characters; and 31 miss by three characters. No taxa miss by four or more characters because we only selected three characters. If 10 or fewer taxa exactly match the characters entered, as is the case here, they will be listed.

If you need to refer to this summary of the results of the last KO command, just type 'SS' [enter] (for Summarize Search). Try this command now.

As a result of the KO command, characters 2, 18, and 21 are now active characters. To list the active characters, we use the LC (List active Characters) command. If we list the active taxa using the LT (List active Taxa) command, we find that there are currently no active taxa. If at any point in using MEKA, you need to know which taxa and characters are active, use the 'LC' and 'LT' commands to list them.

We can make taxa active for use by subsequent commands by the ST (Select Taxa) command. 'ST 0' [enter] makes the three taxa that exactly match active. 'ST 1' [enter] makes the 200 taxa that mismatch by one character active. Note that the taxa are always added to the taxa that are currently active. The taxa that are active prior to the ST command remain active. To clear the active taxa so that none are active, use the CT (Clear Taxa) command. Use the LT command to list the active taxa. Experiment briefly with these commands. You will note that the numbers of active taxa are followed by a '='. If you use the VT and VC commands to view character and taxon names, you will note that the active characters are identified by '+' and the active taxa are identified by '='. Right now clear the active taxa by typing 'CT' [enter] and then select the taxa that match perfectly by typing 'ST 0' [enter].

We can discover the characters that are present or variable in some but not all of the active taxa by entering the command CP (Characters Present). Type 'CP' [enter]. MEKA now lists these characters together with the active taxa in which the character is present. These are the characters that can be used to distinguish among the taxa that are still candidates. The CA and C? commands perform similar functions for characters that are absent and unknown respectively. (There are no characters that are scored unknown in the ANGIOFAM and TROPIFAM keys.) At this point we might continue by adding more characters by the AC command. For example, we might observe that our specimen had stellate hairs. We add this character by typing 'AC 11' [enter]. When we issue the KO command, we find that only the Euphorbiaceae have the combination of states we have entered. If at this point we are not satisfied with the identification, we might decide that the specimen probably lacks stinging hairs. We could then type 'DC 18' [enter] and 'KO' [enter]. We then find out that 76 taxa match exactly. It is very important to keep in mind that characters are not actually added or deleted by the AC and DC commands. The addition or deletion is performed when the subsequent KO command is issued.

If we want to know exactly which of the active character states are mismatched in the active taxa, we can use the LM (List Mismatched characters) command. Reset MEKA to clear the lists of active characters and active taxa by using the RS (ReSet) command: just type 'RS' [enter]. Now use the AC command to select characters 2, 9, 18, 21, and 128: 'AC 2 9 18 21 128' [enter]. Don't forget the KO command. We discover that the Euphorbiaceae matches these character states exactly and that three families mismatch on 1. To make these taxa active, issue the commands 'ST 0' [enter] and 'ST 1' [enter]. If we enter the LT (List active Taxa) command, the four families are listed. We can add some other family to the active taxa by means of the AT (Add Taxa) command. Use 'AT 1' [enter] to add the Magnoliaceae to the list. Note that unlike the AC and DC commands, the taxa are added immediately to the list of active taxa. There is no equivalent of the KO (Key Out) command that needs to be issued. Check that this is true by again listing the active taxa by the LT command. Now if the LM (List Mismatched characters) command is issued, MEKA will list, for each of the active taxa, the active characters that it lacks. You should notice that the taxa do not have to be taxa actually selected as a result of the search by the KO command; we can make any taxa we are interested in active by the AT (Add Taxa) command and discover which of the active characters they lack.

To further illustrate this point, let's shift our attention from keying out a specimen to examining the characteristics of a natural group of families, the Zingiberales. First, use the CT (Clear Taxa) command to erase the list of active taxa without affecting the active characters. To view the taxa, issue the command 'VT 360' [enter]. The Zingiberales are families 366 through 371. To make these families active, enter 'AT 366/371' [enter]. The slash indicates a range of numbers. Note that the slash can be used for ranges of character numbers also. Use the LT command to check the list of active taxa. Now if we enter the LM (List Mismatched characters) command we will discover which of the active characters each family lacks. It is often interesting, for a natural group like this, to list the characters that the members of the group have in common. Issue the CU command to list all characters that are uniform across these taxa. Because this is a natural group the list is quite long. The '-' after character numbers indicates characters that are uniformly absent in all families in this order. The '*' indicates characters that are present in at least one member of every family in the order. We can also get lists of the characters that are not uniform in the order. The CP (Characters Present), CA (Characters Absent), and C? (Characters unknown) commands list characters that are not uniform among the active taxa. Try CA. The taxa that lack each character are listed under the character. It is important to observe the contrast between the action of the LM command and the CA command. The LM command uses only the active characters. The CA command checks all characters. The output from the CP and CA commands can be very lengthy.

To change to a new key without leaving MEKA, use the NK (New Key) command. A hard copy of MEKA output can be obtained using the OU (OUtput) command. The output can be directed to the printer or can be saved in a disk file for word processing.

The QU (QUit) command causes MEKA to terminate execution. At this point you should be able to guide yourself through a session with MEKA. Don't be afraid to experiment and see what happens.

Most users will not need to use the MM (Maximum Mismatches) command. Its only function is to specify the maximum number of mismatched characters that MEKA keeps track of for use by the SS (Summarize Search) and the ST (Select Taxa) command. This really only matters when the DC (Delete Characters) command is used. Only a certain number of characters can be deleted before MEKA just return to the data matrix and rekey all the active characters. This can be time consuming if the data set is large and a large number of characters is active. If the maximum number of mismatches is set too large, MEKA may have to rekey all the active characters whenever any character is deleted. When this number is set lower, several characters can be deleted before all characters must be rekeyed. The copy of MEKA you receive will probably allow you to delete five or more characters before MEKA informs you that all active characters are being searched again.

COMMAND REFERENCE

This is a detailed description of the action of each MEKA command. An example of the usage of each command is given.

MC (MEKA Commmands) or ? Example: 'MC' or '?'

MC or a question mark causes MEKA to display the following summary of MEKA command abbreviations to jog your memory:

```
AC, DC, LC, CC - Add, Delete, List, or Clear active characters
AT, DT, LT, CT - Add, Delete, List, or Clear active taxa
   AC, DC, AT, DT are each followed by a list of characters or taxon numbers; '-'
following a character number indicates absence
KO - Key Out unknown
SS - Summarize Search
ST <n> - Select Taxa with <n> mismatches
CU, CP, CA, C? - Characters Uniform, Characters Present, Characters Absent, or
Characters unknown in some active taxa
RS - ReSet program
MM <n> - set Maximum Mismatches for search summary to <n>
LM - List Mismatched characters for active taxa
VT <n>, VC <n> - View Taxon or Character names beginning with number <n>
```

> - List the next 15 taxon names or character names
< - List the previous 15 taxon names or character names
NK <keyname> - New Key requested named <keyname>
OU <destination> - OUtput to be sent to <destination>
PA - PAuse after full screen; initially on
MC or ? - Meka Commands (this list)
QU - QUit program and return to the operating system

VC (View Characters) Example: 'VC 50'

VC causes MEKA to display the next fifteen character descriptions beginning at the current position in the character description list. If followed by an integer, as in 'VC 50', MEKA displays fifteen character descriptions beginning with number 50. After each display, the current position is incremented by fifteen so that the next time the command is issued, the next fifteen will be displayed. Active characters are indicated by a '+' or '-' after the character number. After VC is issued, the characters '>' and '<' cause MEKA to move forward and backward in the character description list and to display fifteen descriptions each time. The characters '>' and '<' display character descriptions until the next VT command is issued.

VT (View Taxa) Example: 'VT 50'

VT displays taxon names in the same fashion that VC displays character descriptions. Active taxa are indicated by a '=' after the taxon number. After a VT command is issued, '>' and '<' cause taxon names to be displayed until the next VC command is issued.

AC (Add Character) Example: 'AC 2 4/6 10- 13-/17-'

The AC command marks characters for use by the KO (Key Out) command, which will add the indicated characters to the list of active characters. The character numbers are entered on the same line as the AC command and are separated by blanks. To indicate a range of character numbers, use a slash to separate the first number in the range and the last number in the range. For example, '23/45' indicates all the characters from 23 to 45 inclusive. A minus sign ('-') following the character number is used to indicate that the character is absent. If a minus sign follows the character number, then the KO command will score a match for the character if a taxon has one of the states '-', '*', or '?'. If the taxon has the state '+', then KO will score a mismatch for that character. (It is important to remember that in ANGIOFAM and TROPIFAM, only the states '-' and '*' are used. Indicating an absent character will have no effect in searches in these two data sets. This issue is discussed more fully within the specific documentation for ANGIOFAM below.) If no minus sign follows the character number, then the KO command will score a match for the character if a taxon has one of the states '+', '*', or '?'. If the taxon has the state '-', then KO will score a mismatch for that character. The character numbers do not need to be entered in numerical order.

DC (Delete Character) Example: 'DC 10 5 23/27'

The DC command marks characters for deletion from the list of active characters by the subsequent KO command. All mismatches that are scored for taxa based on the deleted character are removed when the KO command deletes the character. The character numbers do not need to be entered in numerical order.

KO (Key Out) Example: 'KO'

The KO command adds or deletes characters from the active character list according to any AC or DC commands that have been issued since the last KO command and updates the mismatch scores based on accessing the data matrix for each character. If the character state indicated in the AC command was '+', then every taxon with the state '-' has one mismatch added to its mismatch score. If the character state indicated in the AC command was '-', then every taxon with the state '+' has one mismatch added to its mismatch score. After performing this search of the data matrix, the KO command automatically invokes the SS (Summarize Search) function described below.

SS (Summarize Search) Example: 'SS'

The SS command summarizes the mismatch scores for all the taxa. It lists the number of taxa that exactly match, followed by the number of taxa that mismatch on one character, followed by the number of taxa that mismatch on two characters, and so on, up to the maximum number of mismatches (which may be changed by the MM command). If the number of taxa that match exactly is less than or equal to ten, then the taxa that match exactly are listed.

ST (Select Taxa) Example: 'ST 0'

The ST command is issued with one parameter, an integer between zero and the maximum number of mismatches, inclusive. ST lists all taxa with the number of mismatches specified by the integer and adds all of these taxa to the list of active taxa. The list of active taxa is not cleared by ST.

AT (Add Taxa) Example: 'AT 1 15 21/45'

AT adds taxa to the list of active taxa. The taxa are indicated by taxon number. Ranges of numbers are indicated by a slash.

DT (Delete Taxa) Example: 'DT 1 15 21/45'

DT deletes taxa from the list of active taxa. The taxa are indicated by taxon number. Ranges of numbers are indicated by a slash.

LC (List active Characters) Example: 'LC'

LC lists all active characters. The symbol '+' after the character number indicates that taxa with state '-' receive a mismatch for that character. The symbol '-' after the character number indicates that taxa with state '+' receive a mismatch for that character.

LT (List active Taxa) Example: 'LT'

LT lists all active taxa.

CC (Clear active Characters) Example: 'CC'

CC removes all characters from the list of active characters and resets the mismatch scores of all taxa to zero.

CT (Clear active Taxa) Example: 'CT'

CT removes all taxa from the list of active taxa.

RS (ReSet) Example: 'RS'

RS is equivalent to issuing CC followed by CT.

LM (List Mismatched characters) Example: 'LM'

LM lists, for each active taxon, the active characters that are mismatched. The symbol after the character number indicates the state of the character possessed by the taxon.

CU (Characters Uniform) Example: 'CU'

CU lists all characters for which all active taxa possess the same state. The symbol after the character number indicates the state that is possessed by all active taxa.

CA (Characters Absent) Example: 'CA'

CA lists, for each character that has the state '-' for some, but not all active taxa, the active taxa that have the state '-'.

CP (Characters Present) Example: 'CP'

CP lists, for each character that has the state '+' or '*' for some but not all active taxa, the active taxa that have either '+' or '*'. The symbol after the taxon number indicates the state of the character possessed by that taxon.

C? (Characters unknown) Example: 'C?'

C? lists, for each character that has the state '?' for some, but not all active taxa, the active taxa that have state '?'.

NK (New Key) Example: 'NK ANGIOFAM'

NK causes MEKA to access a new key. If all key files are on the default drive, simply giving the key name, as in 'NK ANGIOFAM', is sufficient. If all the files are on some other drive, indicating the drive in the standard fashion is sufficient, e.g. 'NK B:ANGIOFAM'. If the four key files are on different drives, then issuing the command with just a colon in front of the key name will cause MEKA to prompt the user for the drive for each of the key files, e.g. 'NK :ANGIOFAM'.

OU (OUtput) Example: 'OU LST:'

OU directs a copy of MEKA output to any valid filename or valid device name. The file or device name follows the command as in 'OU B:MEKAOUT'. To stop copying output, use the argument 'OFF' as in 'OU OFF'. The destination of the output can be changed as often as desired. 'LST:' is the default printer.

PA (PAuse) Example: 'PA'

PA toggles pausing on and off. When pausing is on, MEKA stops writing output to the screen when the screen is full. Pausing is on by default when MEKA begins.

MM (Maximum Mismatches) Example: 'MM 5'

MM sets the maximum number of mismatches that are summarized by the SS command. There is an upper limit that may vary depending on the copy of MEKA you have. If you try to set the maximum number of mismatches above this limit, you will be told what the limit is for your copy. Use 'MM 100' to discover the upper limit for your copy.

QU (QUit) Example: 'QU'

QU causes MEKA to terminate execution.

FORMAT OF MEKA FILES

There are four MEKA files for each key. The key description file is a text file identified by the extent '.DES' that tells the user some basic information about the key such as the taxa, the source of data, the addresses of authors, etc. The other three files are Turbo Pascal random access files. In each of these three files, all records are the same length. There are no line feeds or carriage returns in these file.

The file identified by the extent '.CHR' is the character description file. Each record is 80 ASCII characters long. Each character description occupies just one record. The total number of bytes required for this file is eighty times the number of characters.

The file identified by the extent '.TAX' is the taxon name file. Each record is 40 ASCII characters long. Each taxon name occupies one record. The total number of bytes required for this file is forty times the number of taxa.

The file identified by the extent '.DAT' is the data matrix file. Each record is 40 ASCII characters long. Each ASCII character in the record corresponds the character state of one taxon. The data is arranged by character in the same order as the character descriptions in the file '.CHR'. Within the data for one character, the character states for the taxa are arranged in the same order as the taxon names in the file '.TAX'. The data for one character occupies as many records as necessary. The first ASCII character on the first record for a particular character is the state of taxon number 1, the first ASCII character on the second record is the state of taxon number 41, etc. For example, the ANGIOFAM data set includes 411 taxa. This requires 11 records for each character. The eleventh record for each character contains the character state information for taxa 401 through 411. In this eleventh record, the twelfth through fortieth ASCII characters are blanks. The valid character states are the ASCII characters '+', '-', '*', and '?'. The state '+' (present) means that the character is found in all members of the taxon. The state '-' (absent) means that the character is found in no members of the taxon. The state '*' (variable) means that the character may be either present or absent in a member of the taxon. The state '?' (unknown) means that the condition of the character is not known for the taxon. The number of bytes required by this file can be calculated by determining the smallest multiple of forty greater than or equal to the number of taxa and multiplying this number by the number of characters.

SUPPLEMENTARY DOCUMENTATION FOR ANGIOFAM

The ANGIOFAM MEKA key originates from the punched-card key distributed by Hansen and Rahn (1969). These punched cards were transcribed to machine-readable form at the University of Oklahoma by R. Phillips and D. Hough. Duncan and Meacham (1986) added the corrections published by Hansen and Rahn (1972, 1979) and an additional set of unpublished corrections distributed by Hansen and Rahn. A program was written to plot reconstructions of the original cards from the transcribed data. These plots were compared with the cards to ensure that the data had been transcribed correctly. There should be very few, if any, remaining errors of transcription. The Department of Botany of the British Museum (Natural History) holds the copyright for the ANGIOFAM key. Under the current agreement, users are not permitted to distribute the ANGIOFAM key to third parties. The University of California Herbarium maintains a list of recipients of ANGIOFAM. A copy of K. M. Becker's (1973) article in Taxon comparing the family names used in various classification schemes will help to associate the family concepts used in ANGIOFAM and TROPIFAM to other classification schemes.

In the original set of cards from which the ANGIOFAM data matrix was transcribed, the absence of a hole at a particular position meant that the character is completely absent from the family. The absence of a hole was transcribed to a '-' in the data matrix. However, the presence of a hole could mean that every member of the family has that character or that only some members of the family have that character. The punched-card data format does not distinguish between conditions that would be scored '+' in the data matrix and those that would be scored '*'. This ambiguity requires that holes be transcribed to '*' in MEKA format. Because of this limitation of the original data format, indicating that a character is absent from a specimen cannot eliminate any family as a candidate. Absences of characters are completely uninformative for the present versions of ANGIOFAM and TROPIFAM. New keys that are developed can avoid this limitation.

Becker, Kenneth M. 1973. A comparison of angiosperm classification systems. *Taxon* 22:19-50.

Duncan, Thomas and Christopher A. Meacham. 1986. Multiple-entry keys for the identification of angiosperm families using a microcomputer. *Taxon* 35:492-494.

Hansen, Bertel and Knud Rahn. 1969. Determination of angiosperm families by means of a punched-card system. *Dansk Bot. Archiv* 26:1-46.

_______ and _______. 1972. Determination of angiosperm families by means of a punched-card system. Additions and corrections. I. *Bot. Tidsskr.* 67:152-153.

_______ and _______. 1979. Determination of angiosperm families by means of a punched-card system. Additions and corrections. II. *Bot. Tidsskr.* 74:177-178.

SUPPLEMENTARY DOCUMENTATION FOR TROPIFAM

The basis of the TROPIFAM key is a punched-card key modeled after Hansen and Rahn's key that was produced by D. Simpson and D. Janos in 1974 at the Field Museum of Natural History. This data set was transcribed at the University of California Herbarium.

HOW YOU CAN HELP

If you find MEKA a useful tool, let us know. Such letters would be very helpful in seeking funding for further development and in justifying the effort expended so far. If you have ideas for other commands and features, let us know about that too. If you received MEKA from someone else, please let us know so that your name can be added to our mailing list to receive notices about new developments and new keys that other users are distributing. We eventually hope to compile a large number of MEKA keys to distribute free of charge. Good luck in experimenting with MEKA!

DOCUMENTATION FOR MEKAEDIT

MEKAEDIT is a program to create and edit multiple-entry keys for subsequent access by MEKA. It allows you to interactively enter taxon names, character descriptions, and fill in the data matrix. It is written in Turbo Pascal. Because it uses some special PC-DOS functions to move the cursor around the screen, it is more dependent on the details of the operating system of the machine you have than MEKA, which avoids the use of any machine-dependent functions. The compiled version we supply will run on IBM PCs and exact clones.

THE MAIN SCREEN

When MEKAEDIT is run, the main screen lets you select one of the two primary functions: creating a new MEKA key and editing an existing key. A list of the MEKAEDIT commands can also be called up from this menu.

CREATING A NEW KEY

If the create function is selected, MEKAEDIT will request the name of the key to be created, whether the new key should be in ASCII format or in the compressed binary format (ASCII format is recommended), the number of characters, and the number of taxa. After this information is supplied, MEKAEDIT creates four disk files. For example, if the key is called 'MYKEY', then the four files created by MEKAEDIT will be

MYKEY.DES	Key description text file
MYKEY.CHR	Character description file
MYKEY.TAX	Taxon name file
MYKEY.DAT	Data matrix file.

The first is a dummy key description file that has the extension '.DES'. It contains no text at all when first created by MEKAEDIT. You can fill in this file with text that describes the source and subject of the key with your own word processing program. The second and third are the character description file and the taxon name file, which are filled with blank records and which have the extensions '.CHR' and '.TAX' respectively. The fourth is the data file, which in ASCII mode is filled with question marks representing that the condition of every character is unknown for every taxon. It has the extension '.DAT'. Thus, the key is created essentially as a blank key. Information is added to the file by using the edit mode. The key description file is a sequential file; the other three files are random access files.

EDITING KEYS

After a key has been created, you may add information or make corrections by selecting the edit mode in the main menu. The edit menu allows you to select the file to be edited. A list of the commands MEKAEDIT uses in the edit mode can be generated. MEKAEDIT uses WordStar-like control sequences (^K means to depress the Ctrl key while striking the 'K') or IBM function keys.

LIST OF MEKAEDIT COMMANDS

Function	IBM	WordStar
Return to edit menu	F1	^K^D
Undo changes to this line	F2	^Q^L, ^U
Delete character	Delete	^G
Delete word		^T
Backspace	Backspace	^H
Tab to next field	Tab	Tab
Move left one position	Left arrow, F5	^S
Move right one position	Right arrow, F6	^D
Move up one line	Up arrow, F7	^E
Move down one line	Down arrow, F8	^X
Move left one word (block)	F3	^A
Move right one word (block)	F4	^F
Move up one page	PgUp, F9	^R
Move down one page	PgDn, F10	^C
Move to first line	Home	^Q^R
Move to last line	End	^Q^C

EDITING THE CHARACTER DESCRIPTION AND TAXON NAME FILES

When editing these two files, MEKAEDIT displays the number of the character description or the taxon name that is currently begin edited. Immediately following the number is the description or name itself. The lower part of the screen displays the current line with the lines that come before it and after it in the file. Changes that are made to the current line are not displayed in the lower part of the screen until you leave the line by using, for example, an up arrow, down arrow, or enter.

The easiest way to learn how to use MEKAEDIT is to simply create a trial key and experiment with the commands listed above. You can copy all four ANGIOFAM files to a test copy on a different diskette and then edit this new test copy. For example, the DOS command 'COPY A:ANGIOFAM.* B:TEST.*' would copy the four angiofam files on drive A: to four files on drive B:. After you put the diskette containing the original ANGIOFAM key away in a safe place, try MEKAEDIT on your new copy called "TEST."

The arrow keys can be used to move around in a file. The left and right arrows move the cursor left and right on the same line. The up and down arrow keys move the cursor to new lines. One important function to remember is the undo function, which restores a line to its original state as long as the cursor has not left the line. Once the cursor has left the line, the changes that have been made are permanent. Another is the tab, which moves the cursor to the number field. You can then enter the number of any line and hit tab again (or enter), and the specified line will become the current line. Entering the character descriptions and taxon names is just as easy as typing text into any word processor.

EDITING THE DATA MATRIX FILE

The data matrix file is arranged in blocks. Each block is 40 bytes long. In the ASCII (recommended) mode, a block consists of 40 ASCII characters that correspond to the data for 40 taxa and one character. (In the binary mode, a block consists of 40 bytes with two bits used for each taxon so that 160 taxa are described for one character in one block.) The blocks are arranged by character. Thus, all the blocks for the first character come before the blocks for the second. In the ASCII mode, a '+' means that all members of the taxon have the character; a '-' means that no member of the taxon has the character; a '*' means that at least one member of the taxon has the character and at least one lacks the character; and a '?' means that the condition of the character is unknown for the taxon.

When the data matrix is selected for editing, MEKAEDIT displays a matrix of 20 characters and 10 taxa from the data file. The program also displays the character number, character description, taxon number, taxon name, and character state that correspond to the current cursor position. The program begins in a mode to enable data to be entered or edited character by character. Issuing a ^Q^A command will change this mode so that data can be entered taxon by taxon. Issuing a ^Q^A again changes the mode so that the cursor remain stationary on a single taxon for a single character. This feature will enable a user to choose the most effective mode to enter or edit data. As the cursor is moved about in the matrix, character number, character description, taxon number, taxon name, and character state are continually updated. The left and right arrows move to the data for different taxa in the matrix. If you move out of the matrix to the left or the right, the current matrix will be replaced. The up and down arrows move to different characters. The word left and word right functions move you through consecutive sets of taxa for one character. Page up and page down move you through characters ten at a time.

The tab moves the cursor to the character number field; another tab moves the cursor to the taxon number field. By entering numbers directly in either of these two fields, you can jump immediately to any entry in the matrix. You can type '+', '-', '*', and '?' to change the data if you wish, but the keys '1' through '4' are converted, respectively, to these values in order make data entry easier.

The IBM function key F1 or the WordStar-like command ^K^D will exit the editing function and return you to the main menu.

DON'T FORGET TO MAKE BACKUPS!!!

WHAT THIS VERSION WILL NOT DO

This version does not allow more taxa or characters to be added to an existing key. If you may want to add characters later, create some extra dummy characters. These can be filled in when you need them. Version 1.0 also does not allow taxa or characters be deleted or reordered. These are deficiencies that will be fixed in subsequent versions. The addition of these functions to MEKAEDIT has the highest priority for future work.

TUTORIAL

MARSH Tutorial, Woody key. 11 August, 1993

Demonstration of MEKA commands and procedures used to select characters and identify an unknown species - Box Elder or Ash-leaf Maple (Acer negundo) and review the characters of a specific group (the genus Acer).

A line drawing of the leaves, fruits, and a short portion of the branch from an imaginary 40 foot tree from along a temporarily flooded lake shore in New York State is included for reference during the keying process.

General conceptual approach and keying strategy.

a. Critically inspect the unknown specimen and record any unusual characters such as form, color, texture, or size.
b. Work with critical characters (*) first, thus prioritizing the keying sequence.
c. Select the most obvious and diagnostic characters first.
d. Select characters initially you know for sure. Avoid subjective characters. An incorrect character will eliminate the species.
e. Select state geography as the first character.
f. Key out small groups of selected characters. Entering a long string of characters before you invoke the next KO (KEY OUT) command makes it more difficult to identify an incorrectly scored character.
g. Link keying strategy to command functions. Warning: always invoke LT (LIST [active] TAXA) command before issuing the CP (CHARACTERS PRESENT) command. No more than 3 to 5 taxa should be active to reduce the length of the file to be scanned. A very long file must be completely scrolled to the end before proceeding further.
h. Determinations made using the Aster, Grass, Cyper, Carex, and Juncus keys should always include floral characteristics.
i. Minute characters, such as vestiture (hairs), should be examined with a 16-20 power hand lens.
j. The use of negative character states is strongly discouraged.

Conventions used in this tutorial.

1. User key entry input is presented in **bold** type.
2. Output from screen is shown in normal type.
3. Directions and statements to user are enclosed in { }.

```
C:\

CD MARSH  [Enter]    Move to the MARSH directory.

C:\MARSH

MEKA  [Enter]        Opens and activates the MEKA program within the
                     MARSH directory.

    WELCOME TO MEKA...

ENTER NAME OF KEY TO BE USED:

WOODY  [Enter]       Opens and activates the WOODY key for use by
                     MEKA.

This is the woody key.
  830 taxa, 508 characters, ASCII data format.

ENTER COMMAND        MEKA prompt asking the user to supply a
                     command.

 ?  [Enter]   Displays a summary of the MEKA commands.

                         MEKA COMMANDS

AC,DC,LC,CC - Add,Delete,List,or Clear active characters
AT,DT,LT,CT - Add,Delete,List,or Clear active taxa
  AC,DC,AT,DT are each followed by a list of characters or taxon
numbers; '-' following a character number indicates absence
KO - Key Out unknown
SS - Summarize Search
ST<n> - Select Taxa with <n> mismatches
CU,CP,CA,C? - Characters Uniform, Characters Present, Characters
Absent,or
Characters unknown in some active taxa
RS - ReSet program
MM<n> - set Maximum Mismatches for search summary to <n>
LM - List Mismatched characters for active taxa
VT<n>, VC<n> - View Taxon or Character names beginning with
number<n>
> - List the next 15 taxon names or character names
< - List the previous 15 taxon names or character names
NK <keyname> - New Key requested named <keyname>
OU <destination> - OUtput to be sent to <destination>
PA - PAuse after full screen; initially on
MC or ? - Meka Commands (this list)
QU - QUit program and return to the operating system
```

VT [Enter]	View Taxa. Taxa 1 through 15 are displayed.
VT 40 [Enter]	View Taxa beginning with 40. Fifteen taxa, taxa 40 through 54, are displayed. Note that the Acer species are taxa 41 through 49.
>>>	Move forward three screens (15 taxa per screen.) Taxa 55 to 69, 70 to 84, and 85 to 99 are displayed on successive screens as the Shift and > keys are depressed simultaneously.
VC [Enter]	View Characters. Characters 1 through 15 are displayed.
VC 465 [Enter]	View Characters beginning with character 465. Characters 465 through 479 are displayed.
VC 1 [Enter]	View Characters beginning with 1. Characters 1 through 15 are again displayed.
<<<	Move back three screens (15 characters per screen). Characters 494 to 508, 479 to 493, and 464 to 478 are displayed on successive screens as the Shift and < keys are depressed simultaneously.
AC 471	Add Character 471. Do <u>NOT</u> depress the Enter key. New York is selected as the first character.
>>>	Note that CONTINUE COMMAND now appears rather than ENTER COMMAND, the cursor has been moved one space to the right with a space placed after 471, and the space is blank between 4 and Tree in the character listing.
4 [Enter]	ENTER COMMAND now reappears. Tree is selected as the second character. Pressing the Enter key indicates that you want to stop entering characters.
KO [Enter]	Key Out. MEKA searches the Woody Key data matrix for a positive (+) assignment for both the characters selected. Note that the sum of the taxa matching exactly and those missing by 1 or 2 characters is equal to the total 830 taxa contained in the Woody Key. Of the 830 taxa in the woody key, 147 meet both selection criteria.

```
KEY CHARACTERS SEARCHED

    4+ Tree
  471+ New York
```

```
TAXON SUMMARY BASED ON CHARACTER SEARCH

   147 TAXA MATCH CHARACTERS EXACTLY
   356 TAXA MISS BY  1
   327 TAXA MISS BY  2
     0 TAXA MISS BY  3
     0 TAXA MISS BY  4
     0 TAXA MISS BY  5
     0 TAXA MISS BY  6
```

AC Add Character.

>< Note that Character 4 Tree has a + between 4 and Tree, indicating that Character 4 Tree is now an active character as a result of the previous Key Out command.

>> Character 31 through 45 are displayed in the second screen.

35 Leaves opposite (character 35) is selected.

>>> Characters 76 through 90 are displayed on the third screen.

87 [Enter] Leaves odd pinnately compound is selected as a character.

{ENTER COMMAND now reappears as MEKA prompt.}

KO [Enter] New character(s) selected since the last Key Out command are listed under KEY CHARACTERS SEARCHED. The following message appears on the screen: "Hit space bar for next page: return (enter) for continuous display." Press either key and ENTER COMMAND appears at the bottom of the listing of the 8 taxa that match exactly.

{When long listings spanning many pages (screens) are created, use the space bar to view each succeeding screen. When you have viewed what you need of a long listing, pressing the Enter key will quickly scroll the remainder of the listing across the screen and stop at the bottom of the listing with the ENTER COMMAND prompt displayed on the following line.}

```
 KEY CHARACTERS SEARCHED

    35+ Leaves opposite
    87+ Leaves odd pinnately compound
```

```
TAXON SUMMARY BASED ON CHARACTER SEARCH

     8 TAXA MATCH CHARACTERS EXACTLY
    46 TAXA MISS BY  1
   214 TAXA MISS BY  2
   342 TAXA MISS BY  3
   220 TAXA MISS BY  4
     0 TAXA MISS BY  5
     0 TAXA MISS BY  6
```

```
TAXA THAT EXACTLY MATCH

    44  Acer negundo
   176  Sambucus canadensis
   178  Sambucus racemosa
   523  Fraxinus americana
   527  Fraxinus nigra
   528  Fraxinus pennsylvanica
   529  Fraxinus profunda
   780  Staphylea trifolia
```

ST 0 [Enter]	Select Taxa. Selects and activates those taxa that match the active characters exactly (0 mismatches). Note that the eight taxa now have an = sign between the taxon number and the scientific name.
DT 523/529 [Enter]	Delete Taxa. This command can be used to delete selected taxa from the active taxa list if, for example, you know the unknown specimen is not any of the Ash (<u>Fraxinus</u>) species, taxa 523 through 529.
LT [Enter]	Note that the four <u>Fraxinus</u> taxa are no longer active taxa.
SS [Enter]	Search Summary. Regenerates the TAXON SUMMARY BASED ON CHARACTER SEARCH and the TAXA THAT MATCH EXACTLY. Note that the four <u>Fraxinus</u> taxa do not have an = sign, again confirming that they are not active taxa.
LC [Enter]	List Characters. Lists the characters selected and thus activated.
AC	Add character.
>	Displays characters 91 to 105 on the screen.
94 [Enter]	Number of leaflets 3 is selected.

KO [Enter] Key Out. New characters selected since the last Key Out command are listed in KEY CHARACTERS SEARCHED.

```
 KEY CHARACTERS SEARCHED

   94+ Number of leaflets 3

 TAXON SUMMARY BASED ON CHARACTER SEARCH

     2 TAXA MATCH CHARACTERS EXACTLY
    11 TAXA MISS BY  1
    53 TAXA MISS BY  2
   210 TAXA MISS BY  3
   335 TAXA MISS BY  4
   219 TAXA MISS BY  5
     0 TAXA MISS BY  6

 TAXA THAT EXACTLY MATCH

    44= Acer negundo
   780= Staphylea trifolia
```

LC [Enter] List active characters.

```
 ACTIVE CHARACTERS

    4+ Tree
   35+ Leaves opposite
   87+ Leaves odd pinnately compound
   94+ Number of leaflets 3
  471+ New York
```

DC 94 [Enter] Delete Character 94. This will delete a character that you may be unsure of, such as in this case whether the 3 leaflet material is the normal condition.

KO [Enter] The # following 94 indicates that character 94 has been deleted from the active character list.

```
 KEY CHARACTERS SEARCHED

    94# Number of leaflets 3
```

```
TAXON SUMMARY BASED ON CHARACTER SEARCH

     8 TAXA MATCH CHARACTERS EXACTLY
    46 TAXA MISS BY  1
   214 TAXA MISS BY  2
   342 TAXA MISS BY  3
   220 TAXA MISS BY  4
     0 TAXA MISS BY  5
     0 TAXA MISS BY  6

TAXA THAT EXACTLY MATCH

    44= Acer negundo
   176= Sambucus canadensis
   178= Sambucus racemosa
   523  Fraxinus americana
   527  Fraxinus nigra
   528  Fraxinus pennsylvanica
   529  Fraxinus profunda
   780= Staphylea trifolia
```

{Press space bar for next page and to display the ENTER COMMAND prompt.}

LC [Enter] List (active) Characters. This confirms that character 94 is not included in the current list of active characters.

```
ACTIVE CHARACTERS

    4+ Tree
   35+ Leaves opposite
   87+ Leaves odd pinnately compound
  471+ New York
```

AC

>>>>>

178 [Enter]

KO [Enter]

```
KEY CHARACTERS SEARCHED

   178+ Leaves 1 to 1.25 times longer than broad
```

```
TAXON SUMMARY BASED ON CHARACTER SEARCH

    3 TAXA MATCH CHARACTERS EXACTLY
   25 TAXA MISS BY  1
   96 TAXA MISS BY  2
  221 TAXA MISS BY  3
  310 TAXA MISS BY  4
  175 TAXA MISS BY  5
    0 TAXA MISS BY  6

TAXA THAT EXACTLY MATCH

   44= Acer negundo
  176= Sambucus canadensis
  178= Sambucus racemosa
```

LC [Enter]

```
ACTIVE CHARACTERS

    4+ Tree
   35+ Leaves opposite
   87+ Leaves odd pinnately compound
  178+ Leaves 1 to 1.25 times longer than broad
  471+ New York
```

LT [Enter]

```
ACTIVE TAXA

   44= Acer negundo
  176= Sambucus canadensis
  178= Sambucus racemosa
  780= Staphylea trifolia
```

CT [Enter] Clear Taxa. Clears all active taxa.

LT [Enter] List (active) Taxa. This confirms that no taxa are active.

```
ACTIVE TAXA
```

ST 0 [Enter] This selects and activates the three taxa that match the active characters exactly. Note the = sign following each taxa number indicating that the taxa are now active.

```
TAXA THAT MATCH CHARACTER DATA EXACTLY

   44= Acer negundo
  176= Sambucus canadensis
  178= Sambucus racemosa
```

LT [Enter] Confirms the active status of the three taxa.

```
 ACTIVE TAXA

    44= Acer negundo
   176= Sambucus canadensis
   178= Sambucus racemosa
```

VT 40 [Enter] Note in the taxa listing that Acer negundo (taxa 44) is now preceded by an = sign that denotes currently active taxa.

VT 170 [Enter] Note in the taxa listing that Sambucus canadensis (taxa 176) and Sambucus racemosa (taxa 178) are now preceded by an = sign that denotes currently active taxa.

CP [Enter] Characters Present in some but not all active taxa. This command lists, for each character that has the state (+) or (*) for some but not all active taxa, the active taxa that have either + or *.

This command displays for the active taxa those characters that have not been used thus far in current keying session that separate one or more of the active taxa. A suggested strategy is to review the characters listed and note those possessed by the unknown specimen. A suite of non-subjective characters will produce the most accurate determination. A single taxon listed for a non-subjective character, such as Character 75 (Leaf lobes pointed) in the following CP listing, means that if that character is added to the current list of active characters, a subsequent Key Out will select only that taxon.

{Press space bar for next page (screen).}

```
 CHARACTERS PRESENT IN SOME (BUT NOT ALL) ACTIVE TAXA

     2  Shrub
       176+ Sambucus canadensis
       178+ Sambucus racemosa

    10  Plant height 0.5-1 m
       176* Sambucus canadensis
       178* Sambucus racemosa

    11  Plant height 1-4 m
       176* Sambucus canadensis
       178* Sambucus racemosa
```

```
12  Plant height 4 m or more
    44+ Acer negundo

23  Leaf length 5-10 cm
    44* Acer negundo

34  Number of lateral leaf veins 10 or more
    44* Acer negundo

62  Leaves lanceolate
   176+ Sambucus canadensis
   178+ Sambucus racemosa

64  Leaves oblanceolate
    44+ Acer negundo

65  Leaves oblong
   176+ Sambucus canadensis
   178+ Sambucus racemosa

66  Leaves obovate
    44+ Acer negundo

67  Leaves orbicular
    44+ Acer negundo

74  Leaves palmately lobed
    44+ Acer negundo

75  Leaf lobes pointed
    44+ Acer negundo

77  Number of leaf lobes 3 or fewer
    44+ Acer negundo

82  Leaf teeth/lobes present only below middle
    44+ Acer negundo

84  Terminal leaf lobe concave
    44+ Acer negundo

85  Terminal leaf lobe convex
    44+ Acer negundo

94  Number of leaflets 3
    44* Acer negundo

95  Number of leaflets 4
    44* Acer negundo
   98  Number of leaflets 8 or 9
         44* Acer negundo
        176* Sambucus canadensis

   99  Number of leaflets 10 or more
        176* Sambucus canadensis

     (Listing truncated)
```

{Press Enter key to scroll to end of listing and display the ENTER COMMAND prompt.}

```
SS  [Enter]    Search Summary.
```

```
 TAXON SUMMARY BASED ON CHARACTER SEARCH

     3 TAXA MATCH CHARACTERS EXACTLY
    25 TAXA MISS BY  1
    96 TAXA MISS BY  2
   221 TAXA MISS BY  3
   310 TAXA MISS BY  4
   175 TAXA MISS BY  5
     0 TAXA MISS BY  6

 TAXA THAT EXACTLY MATCH

    44= Acer negundo
   176= Sambucus canadensis
   178= Sambucus racemosa
```

```
LC  [Enter]
```

```
 ACTIVE CHARACTERS

     4+ Tree
    35+ Leaves opposite
    87+ Leaves odd pinnately compound
   178+ Leaves 1 to 1.25 times longer than broad
   471+ New York
```

```
VC 70  [Enter]

AC 75  [Enter]
```

KO [Enter]

```
 KEY CHARACTERS SEARCHED

   75+ Leaf lobes pointed

 TAXON SUMMARY BASED ON CHARACTER SEARCH

     1 TAXA MATCH CHARACTERS EXACTLY
     6 TAXA MISS BY  1
    43 TAXA MISS BY  2
   113 TAXA MISS BY  3
   211 TAXA MISS BY  4
   289 TAXA MISS BY  5
   167 TAXA MISS BY  6

 TAXA THAT EXACTLY MATCH

   44= Acer negundo
```

{This preliminary identification of the unknown specimen should now be verified against the description and figure from a botanical manual covering the area where the specimen was collected.}

LT [Enter] Note that all the active taxa created by the former ST 0 command are still maintained as active until deactivated.

```
 ACTIVE TAXA

    44= Acer negundo
   176= Sambucus canadensis
   178= Sambucus racemosa
```

CT [Enter] Clear Taxa. Clear all active taxa.

LT [Enter] To confirm that no taxa are currently maintained as active.

```
 ACTIVE TAXA
```

LC [Enter]

SS [Enter] Note that there is no = sign between 44 and Acer negundo, confirming that this is not an active taxon.

ST 0 [Enter] Select Taxa that match the characters selected exactly.

```
 TAXA THAT MATCH CHARACTER DATA EXACTLY

    44= Acer negundo
```

LT [Enter] To confirm that only taxa 44 is active.

```
 ACTIVE TAXA

    44= Acer negundo
```

SS [Enter] Confirms that Taxon 44 Acer negundo is now an active taxon.

CU [Enter] Characters Uniform lists all characters for which all active taxa possess the same state. Note that all characters are listed when only one taxon is active when the CU command is issued.

This summation of all characters scored as always (+) or variably (*) occurring in a taxon provides a complete description of the taxon against which the unknown specimen can be compared.

{Press space bar to scroll to end of next page (screen).}

```
 CHARACTERS UNIFORM AMONG ACTIVE TAXA

     1- Herb or subshrub
     2- Shrub
     3- Vine or liana
     4+ Tree
     5- Palm-like
     6- Cactus-like
     7+ Plant erect
     8- Plant trailing
     9- Plant height 0.5 m or less
    10- Plant height 0.5-1 m
    11- Plant height 1-4 m
    12+ Plant height 4 m or more
    13+ Leaves deciduous
    14- Leaves evergreen
    15+ Leaves membranaceous
    16- Leaves coreaceous
    17- Leaves succulent
    18- Leaves glossy
    19- Leaf length 0.3 cm or less
    20- Leaf length 0.3-1 cm
    21- Leaf length 1-3 cm
    22- Leaf length 3-5 cm
    23* Leaf length 5-10 cm
    24* Leaf length 10 cm or more
    25- Leaf width 0.1 cm or less
    26- Leaf width 0.1-0.4 cm
    27- Leaf width 0.4-1 cm
    28- Leaf width 1-3 cm
    29- Leaf width 3-6 cm
    30+ Leaf width 6 cm or more
    31- Number of lateral leaf veins none
    32- Number of lateral leaf veins 1 to 4
    33* Number of lateral leaf veins 5 to 9
    34* Number of lateral leaf veins 10 or more
    35+ Leaves opposite
    36- Leaves alternate
    37- Leaves whorled
    38- Leaves basal
    39- Leaves in fascicles of 2

     (Listing truncated)
```

{Press Enter key to scroll to end of listing and display the ENTER COMMAND prompt.}

LT [Enter]

```
 ACTIVE TAXA

    44= Acer negundo
```

CT [Enter] Clear Taxa. Removes all taxa from the list of active taxa.

LT [Enter] To confirm that no taxa are currently active.

```
 ACTIVE TAXA
```

SS [Enter]

```
 TAXON SUMMARY BASED ON CHARACTER SEARCH

      1 TAXA MATCH CHARACTERS EXACTLY
      6 TAXA MISS BY 1
     43 TAXA MISS BY 2
    113 TAXA MISS BY 3
    211 TAXA MISS BY 4
    289 TAXA MISS BY 5
    167 TAXA MISS BY 6

 TAXA THAT EXACTLY MATCH

    44 Acer negundo
```

ST 1 [Enter] Select and activate the 6 taxa which mismatch by one character.

```
 TAXA WITH 1 MISMATCHED CHARACTER(S)

    45= Acer pensylvanicum
    46= Acer rubrum
    49= Acer spicatum
   176= Sambucus canadensis
   178= Sambucus racemosa
   549= Clematis terniflora
```

LM [Enter] List Mismatched characters for active taxa. This lists for each taxa the character that did not meet one of the 5 characters selected. The minus (-) following the character number indicates that the character was scored as not being possessed at all by the taxon.

```
 ACTIVE TAXA WITH MISMATCHED ACTIVE CHARACTERS

    45= Acer pensylvanicum
        87- Leaves odd pinnately compound

    46= Acer rubrum
        87- Leaves odd pinnately compound

    49= Acer spicatum
        87- Leaves odd pinnately compound

   176= Sambucus canadensis
        75- Leaf lobes pointed

   178= Sambucus racemosa
        75- Leaf lobes pointed

   549= Clematis terniflora
          4- Tree
```

LT [Enter]

```
 ACTIVE TAXA

    45= Acer pensylvanicum
    46= Acer rubrum
    49= Acer spicatum
   176= Sambucus canadensis
   178= Sambucus racemosa
   549= Clematis terniflora
```

CT [Enter] Clear all active taxa.

```
LT  [Enter]

VT 40  [Enter]

AT 41/49  [Enter]   Make taxa 41 through 49 active.

LT  [Enter]

 ACTIVE TAXA

    41= Acer circinatum
    42= Acer glabrum
    43= Acer macrophyllum
    44= Acer negundo
    45= Acer pensylvanicum
    46= Acer rubrum
    47= Acer saccharinum
    48= Acer saccharum
    49= Acer spicatum

CP  [Enter]   Characters Present lists, for each character that
              has the state (+) or (*) for some but not all active
              taxa, the active taxa that have either + or *.

{Press space bar for next page (screen).}

 CHARACTERS PRESENT IN SOME (BUT NOT ALL) ACTIVE TAXA

      2  Shrub
         41+ Acer circinatum
         42+ Acer glabrum
         45+ Acer pensylvanicum
         49+ Acer spicatum

      3  Vine or liana
         41+ Acer circinatum

      8  Plant trailing
         41+ Acer circinatum

     10  Plant height 0.5-1 m
         42* Acer glabrum

     11  Plant height 1-4 m
         41* Acer circinatum
         42* Acer glabrum

     18  Leaves glossy
         47+ Acer saccharinum
         48+ Acer saccharum
```

```
21  Leaf length 1-3 cm
    41* Acer circinatum
    42* Acer glabrum
    46* Acer rubrum
    47* Acer saccharinum

22  Leaf length 3-5 cm
    41* Acer circinatum
    42* Acer glabrum
    43* Acer macrophyllum
    46* Acer rubrum
    47* Acer saccharinum

24  Leaf length 10 cm or more
    42* Acer glabrum
    43* Acer macrophyllum
    44* Acer negundo
    45* Acer pensylvanicum
    47* Acer saccharinum
    48* Acer saccharum
    49* Acer spicatum

28  Leaf width 1-3 cm
    41* Acer circinatum
    42* Acer glabrum
    47* Acer saccharinum

29  Leaf width 3-6 cm
    41* Acer circinatum
    42* Acer glabrum
    46* Acer rubrum
    47* Acer saccharinum
    49* Acer spicatum

33  Number of lateral leaf veins 5 to 9
    44* Acer negundo

34  Number of lateral leaf veins 10 or more
    44* Acer negundo

58  Leaves simple
    41+ Acer circinatum
    42+ Acer glabrum
    43+ Acer macrophyllum
    45+ Acer pensylvanicum
    46+ Acer rubrum
    47+ Acer saccharinum
    48+ Acer saccharum
    49+ Acer spicatum
```

(Listing truncated)

{Press Enter key to scroll to end of listing and display the ENTER COMMAND prompt.}

LT [Enter]

```
 ACTIVE TAXA

    41= Acer circinatum
    42= Acer glabrum
    43= Acer macrophyllum
    44= Acer negundo
    45= Acer pensylvanicum
    46= Acer rubrum
    47= Acer saccharinum
    48= Acer saccharum
    49= Acer spicatum
```

CU [Enter] Characters Uniform displays for the active taxa all characters that are uniformly possessed (always [+] or variably in some members of each taxa [*]) or are absent (-) in all members of the group.

This listing provides those characters scored consistently across all active taxa, in this case, all the members of the genus Acer. The * in character 23 indicates that all Acer taxa had leaves of variable length that always included leaf lengths of from 5 to 10 cm and one or more shorter leaf length character states.

{Press space bar for next page (screen).}

```
 CHARACTERS UNIFORM AMONG ACTIVE TAXA

     1- Herb or subshrub
     4+ Tree
     5- Palm-like
     6- Cactus-like
     7+ Plant erect
     9- Plant height 0.5 m or less
    13+ Leaves deciduous
    14- Leaves evergreen
    15+ Leaves membranaceous
    16- Leaves coreaceous
    17- Leaves succulent
    19- Leaf length 0.3 cm or less
    20- Leaf length 0.3-1 cm
    23* Leaf length 5-10 cm
    25- Leaf width 0.1 cm or less
    26- Leaf width 0.1-0.4 cm
    27- Leaf width 0.4-1 cm
    31- Number of lateral leaf veins none
    32- Number of lateral leaf veins 1 to 4
    35+ Leaves opposite
    36- Leaves alternate
    37- Leaves whorled
    38- Leaves basal
    39- Leaves in fascicles of 2
    40- Leaves in fascicles of 3 or 4
    41- Leaves in fascicles of 5
    42- Leaves in fascicles of 6 or more
    43- Leaves spirally arranged
    44- Leaves clustered
    45- Leaves 2-ranked
    46- Leaves needle- or scale-like

     (Listing truncated)
```

{Press Enter key to scroll to end of listing and display the ENTER COMMAND prompt.}

LT [Enter]

```
 ACTIVE TAXA

    41= Acer circinatum
    42= Acer glabrum
    43= Acer macrophyllum
    44= Acer negundo
    45= Acer pensylvanicum
    46= Acer rubrum
    47= Acer saccharinum
    48= Acer saccharum
    49= Acer spicatum
```

CA [Enter] Characters Absent lists, for each character that has the state (-) for some, but not all active taxa, the active taxa that have the state -. Note that the taxa listed are those scored as not possessing (-) the character and are thus the remaining Acer taxa not listed by the CP (Character Present) command previously employed.

{Press space bar for next page (screen).}

```
 CHARACTERS ABSENT IN SOME (BUT NOT ALL) ACTIVE TAXA

      2  Shrub
         43- Acer macrophyllum
         44- Acer negundo
         46- Acer rubrum
         47- Acer saccharinum
         48- Acer saccharum
 3  Vine or liana
    42- Acer glabrum
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum

 8  Plant trailing
    42- Acer glabrum
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum

10  Plant height 0.5-1 m
    41- Acer circinatum
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum

11  Plant height 1-4 m
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum

18  Leaves glossy
    41- Acer circinatum
    42- Acer glabrum
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    49- Acer spicatum
```

```
21  Leaf length 1-3 cm
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    48- Acer saccharum
    49- Acer spicatum

22  Leaf length 3-5 cm
    44- Acer negundo
    45- Acer pensylvanicum
    48- Acer saccharum
    49- Acer spicatum

24  Leaf length 10 cm or more
    41- Acer circinatum
    46- Acer rubrum

28  Leaf width 1-3 cm
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    46- Acer rubrum
    48- Acer saccharum
    49- Acer spicatum

29  Leaf width 3-6 cm
    43- Acer macrophyllum
    44- Acer negundo
    45- Acer pensylvanicum
    48- Acer saccharum

33  Number of lateral leaf veins 5 to 9
    41- Acer circinatum
    42- Acer glabrum
    43- Acer macrophyllum
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum

34  Number of lateral leaf veins 10 or more
    41- Acer circinatum
    42- Acer glabrum
    43- Acer macrophyllum
    45- Acer pensylvanicum
    46- Acer rubrum
    47- Acer saccharinum
    48- Acer saccharum
    49- Acer spicatum
    58  Leaves simple
        44- Acer negundo

   (Listing truncated)
```

{Press Enter key to scroll to end of listing and display the ENTER COMMAND prompt.}

```
SS  [Enter]

 TAXON SUMMARY BASED ON CHARACTER SEARCH

      1 TAXA MATCH CHARACTERS EXACTLY
      6 TAXA MISS BY  1
     43 TAXA MISS BY  2
    113 TAXA MISS BY  3
    211 TAXA MISS BY  4
    289 TAXA MISS BY  5
    167 TAXA MISS BY  6

 TAXA THAT EXACTLY MATCH

     44= Acer negundo

LC  [Enter]

 ACTIVE CHARACTERS

      4+ Tree
     35+ Leaves opposite
     75+ Leaf lobes pointed
     87+ Leaves odd pinnately compound
    178+ Leaves 1 to 1.25 times longer than broad
    471+ New York

LT  [Enter]

 ACTIVE TAXA

     41= Acer circinatum
     42= Acer glabrum
     43= Acer macrophyllum
     44= Acer negundo
     45= Acer pensylvanicum
     46= Acer rubrum
     47= Acer saccharinum
     48= Acer saccharum
     49= Acer spicatum
```

DT 41/43 45/49 [Enter] Delete Taxa 41 through 43 and 45 through 49. This deactivates these taxa and makes them unavailable for use by other MEKA commands.

LT [Enter] Confirms that only taxa 44 is left as an active taxa.

```
 ACTIVE TAXA

    44= Acer negundo
```

LC [Enter]

```
 ACTIVE CHARACTERS

     4+ Tree
    35+ Leaves opposite
    75+ Leaf lobes pointed
    87+ Leaves odd pinnately compound
   178+ Leaves 1 to 1.25 times longer than broad
   471+ New York
```

RS [Enter] ReSet the program and clear all active taxa and characters.

LT [Enter]

```
 ACTIVE TAXA
```

LC [Enter]

```
 ACTIVE CHARACTERS
```

NK ASTER [Enter] New Key. To change to a new key, in this case the Aster key.

```
This is the aster key.

   522 taxa,   323 characters,   ASCII data format
```

QU [Enter] To quit MEKA and return to operating system.

```
C:\MARSH
```

{Additional MEKA commands which allow the capture into a disk file of the results displayed on the screen while using the MARSH system.}

OU [Enter]	OUtput to a disk file or device such as a printer. Enter the device or file name including the complete pathway you wish the output from the screen to be copied into, such as C:\MARSH\ASTEROUT. To stop copying output to a file, type OU OFF and press the [Enter] key. Exit MARSH by typing QU and pressing the [Enter] key. C:\MARSH will now be displayed. To view the contents of the ASTEROUT file, enter TYPE ASTEROUT ¦ MORE followed by pressing the [Enter] key. The first screen (page) of the file will be displayed and repeatedly pressing the Enter key will allow you to scroll down through the file one screen at a time. To exit the file, press the Control (Ctrl) and C keys simultaneously.
PA [Enter]	PAuse after a full screen is displayed. Pausing is on by default when MEKA begins. The PA command toggles pausing on and off to allow long listings of more than one page (screen) in length to be written to a file selected by the OUput command without the user having to press the space bar or Enter key. A confirmation of the current status of the PAuse command is displayed on the screen after each PA command is issued.

ACNEDEMO.893